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Water Supply and Pollution Control

# WATER PESTICIDES NO. 1

## STUDY NUMBER 24

## ANALYTICAL REFERENCE SERVICE

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U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service

# WATER PESTICIDES NO. 1

## Study Number 24

Report of a Study Conducted by the

ANALYTICAL REFERENCE SERVICE

Raymond J. Lishka

TRAINING PROGRAM

Robert A. Taft Sanitary Engineering Center
Cincinnati, Ohio

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
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Joseph F. Santner, Mathematical Sciences, Office of the Director, reviewed and suggested some changes in the statistical treatment of the data which were adopted.

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# FOREWORD

The Analytical Reference Service (ARS) is conducted by the Environmental Health Sciences and Engineering Training Program of the Robert A. Taft Sanitary Engineering Center to evaluate laboratory methods in the environmental field. Cooperative studies by member organizations, who analyze identical samples and critically review methodology, provide the mechanism for:

> Evaluation of analytical procedures, including precision and accuracy, by comparison of the procedures and results reported by participating laboratories.
>
> Exchange of information regarding method characteristics.
>
> Improvement or replacement of existing methods by development of more accurate procedures, and development of new methodology for determination of new pollutional compounds.

Samples are designed to contain measured amounts of selected constituents. Decisions as to qualitative makeup are made by the ARS staff, the membership, and consultants. Notice of each study is sent to the entire membership.

To those who desire to participate, a portion of the study sample is sent, along with data forms for reporting numerical values, a critique of the procedures used, comments on modifications, sources of error, difficulties encountered, or other pertinent factors. The results and comments received are compiled, and a report of each study is prepared.

Initially directed toward examination of water, studies now include air, milk, and food. Some studies are periodically repeated for the advantage of new members, to evaluate new methods, or to reevaluate existing methods.

The selection of studies is guided by the responses to questionnaires periodically circulated among the membership, which now includes 293 Federal, state, and municipal agencies; industries; universities; consulting firms; and foreign agencies.

James P. Sheehy
Director, Training Program

## STUDIES COMPLETED AND REPORTED

| | |
|---|---|
| Water-Minerals | Calcium, magnesium, hardness, sulfate, chloride, alkalinity, nitrite, nitrate, sodium, and potassium. Studies completed in 1956, 1958, and 1961. |
| Water-Metals | Lead, copper, cadmium, aluminum, chromium, iron, manganese, and zinc; studies completed in 1957 and 1962. These same metals plus silver; study completed in 1965. |
| Water-Fluoride | Fluoride in the presence and absence of interferences, with and without distillation by a specified procedure. Studies completed in 1958 and 1961. |
| Water-Radioactivity | Gross beta activity; studies completed in 1959 and 1961. Gross beta and strontium-90 activity; study completed in 1963. |
| Water-Surfactant | Surfactant in various waters. Studies completed in 1959 and 1963. |
| Water-Oxygen Demand | Biochemical oxygen demand and chemical oxygen demand; study completed in 1960. Chemical oxygen demand; study completed in 1965. |
| Water-Trace Elements | Arsenic, boron, selenium, and beryllium. Study completed in 1962. |
| Freshwater Plankton | Evaluation of the precision and accuracy obtainable by the use of various methods of plankton counting and identification. Study completed in 1964. |
| Air-Inorganics | Chloride, sulfate, fluoride, and nitrate in aqueous solution and on glass-fiber hi-vol filter mats. Study completed in 1958. |
| Air-Lead | Filter paper tape impregnated with lead. Study completed in 1961. |
| Air-Particulates | Microscopic identification of some common atmospheric particulates. Study completed in 1964. |
| Air-Sulfur Dioxide | Sulfur dioxide in air by a specified method. Study completed in 1963. |

| | |
|---|---|
| Water-Pesticides | Lindane, heptachlor epoxide, DDE and dieldrin in water. Study completed in 1965. |
| Food-Pesticides | DDT in milk. Study completed in 1962. Lindane, heptachlor epoxide, DDE and dieldrin in milk. Study completed in 1965. |

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## ABSTRACT

In this study, two solutions of ethyl acetate containing different mixtures of lindane, heptachlor epoxide, DDE, and dieldrin were analyzed, both before and after dilution with water, by 31 participating laboratories. One participant used paper chromatography, and the rest used gas chromatography; four of the latter employed the microcoulometric detector, and the rest used the electron capture detector. Best results were obtained with a mixed column packing containing both polar and nonpolar materials. Satisfactory results were also obtained with a single-component column when a prior separation of the pesticides by passage through a florisil or alumina chromatographic column was made before injection on the gas chromatograph. The newer model C-200 Dohrmann* microcoulometer produced satisfactory results at the concentrations present in this sample. Failure to correct adequately for incomplete recovery of pesticide in the extraction procedure produced low results in the diluted sample.

Results showed that the average laboratory should be able to measure lindane within $\pm 0.1$ µg/liter and heptachlor epoxide, DDE, and dieldrin within $\pm 0.2$ µg/liter.


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* Mention of commercial products does not imply endorsement by the Public Health Service.

# WATER PESTICIDES NO. 1

## PURPOSE OF THE STUDY

Mr. R.A. Moffitt of the Carnation Milk Company, Research Laboratories, Van Nuys, California, for the past several years has been conducting a series of collaborative studies on analysis of pesticides in milk. Because of greatly increased participation in these studies, Mr. Moffitt requested the assistance of the Analytical Reference Service (ARS) in statistical analysis of the results and in preparation of the report.

The design of the milk pesticide study was such that the pesticide solutions used to spike a milk sample could also be used to spike a water sample. The scope of the study was expanded, therefore, to include instructions for preparing a water sample, and by inviting the participation of all ARS members as well as the laboratories that had been collaborating with Mr. Moffitt. It was felt that the increased participation would provide a more comprehensive study of the methods in use and would increase the validity of precision and accuracy of figures. The study would also afford the participants an opportunity to evaluate their own proficiency in pesticide analysis.

## DESIGN OF THE STUDY

A combination of some of the most commonly used chlorinated hydrocarbon insecticides that would be somewhat difficult to extract, separate, and detect was selected. Concentrations were selected that could cause concern if found in drinking water and yet were low enough to require a considerable degree of skill for accurate measurement. Two solutions were prepared with similar concentrations of lindane and heptachlor epoxide, but with twice as much dieldrin as DDE in one and twice as much DDE as dieldrin in the other. This scheme was designed to evaluate the mutual interference between DDE and dieldrin.

The samples were prepared by Mr. Moffitt at the Carnation Research Laboratories by dissolving carefully measured amounts of the purest available pesticides (supplied by the Analytical Reference Service) in ethyl acetate that had been redistilled in an all-glass still. Aliquots of the sample were sealed in glass ampoules, which were shipped to the participants along with instructions and report forms. Thirty-one laboratories participated in this study.

Analysis of the two pesticide solutions in the ampoules involved only a possible dilution before injection on the gas chromatograph. These solutions, in effect, constituted standards with which the measurement technique could be evaluated. This same solution, when diluted with water according to instructions, approximated actual water samples that, if analyzed, would require additional treatment such as extraction and concentration. The diluted samples, therefore, could be used to evaluate the efficiency of the extraction procedure.

To better evaluate the extraction procedure, each participant was asked to prepare two identical dilutions of each solution and to extract and analyze in duplicate.

## TREATMENT OF THE DATA

The mean of the results reported by each participant was plotted on normal probability paper to determine the distribution. Values showing a gross deviation from the normal distribution line were rejected as nonrepresentative because of errors in calculation, dilution, or other indeterminate factors. These rejected values were not included in the development of statistical parameters. Where mathematical errors were noted or suspected, the participant was so informed, and if corrected values were submitted, they were used in the report.

Calculation of the standard deviations was based on the difference between the average result submitted by each participant and the overall mean value. The average reported values were also used in the bar charts.

The average assay deviation used in the Tables is the average deviation of each replicate assay of a sample or sample extract from the mean of the replicates; the average extract deviation is the average deviation of each assay mean from the extract mean (the overall mean for both extracts).

## DICUSSION

Of the 31 participants in this study, one used paper chromatography to measure lindane, heptachlor epoxide, DDE and dieldrin and the others used gas chromatography; 26 of the latter used the electron capture detector, and four used microcoulometric titration.

Many types and combinations of gas chromatographic columns were used. The liquid phases for these columns consisted almost entirely of QF-1 either alone or mixed with DC-200 or SE-30, or of DC-200, SE-30 or DOW-11 alone.

In most cases the pesticides were extracted from the water with a solvent such as hexane or ether and then directly determined by gas chromatography. Only 9 laboratories used either a florisil or an alumina column, or thin-layer chromatography to accomplish additional cleanup and/or separation prior to determination by gas chromatography.

## LINDANE

Table 1 summarizes statistically the data for lindane received from the various participants. The information is also presented in bar graphs (Figures 1 and 2).

Table 1. SUMMARY OF STATISTICAL DATA FOR LINDANE

| | Pesticide solution A µg/ml | Pesticide solution B µg/ml | Water sample A µg/l | Water sample B µg/l |
|---|---|---|---|---|
| Amount added | 1.017 | 1.085 | 0.508 | 0.542 |
| Mean | 1.07 | 1.02 | 0.44 | 0.42 |
| Median | 1.03 | 1.03 | 0.48 | 0.44 |
| 50% Range | ±0.04 | ±0.08 | ±0.08 | ±0.10 |
| Standard deviation | 0.13 | 0.14 | 0.16 | 0.14 |
| Relative error | 5.21 | 6.08 | 13.78 | 22.88 |
| Average assay deviation | 0.03 | 0.04 | 0.02 | 0.02 |
| Average extract deviation | ---- | ---- | 0.02 | 0.02 |
| Number of results | 22 | 21 | 26 | 26 |

The mean of the total results was a little high for pesticide solution A but was low for the other three samples. For both sample A and B, the mean of the water sample results is considerably lower than the amount added. This loss may be due to incomplete recovery of pesticide in the extraction and failure to apply a correction. In general, the results for lindane showed better precision than did the results for the other pesticides. The precision between laboratories was considerably less than the precision within each laboratory. There

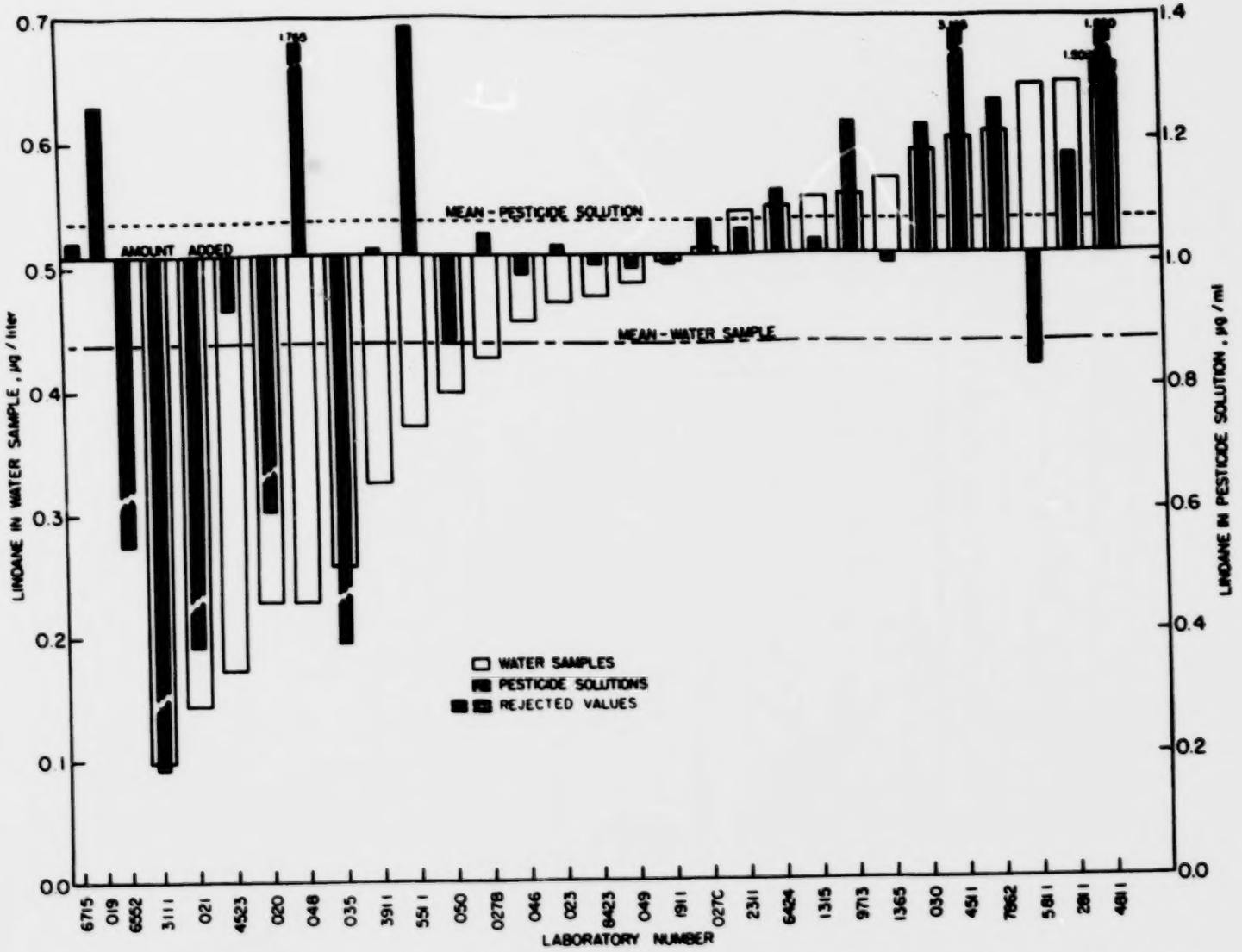


Figure 1. Bar graph for lindane in pesticide solution A and water sample A.

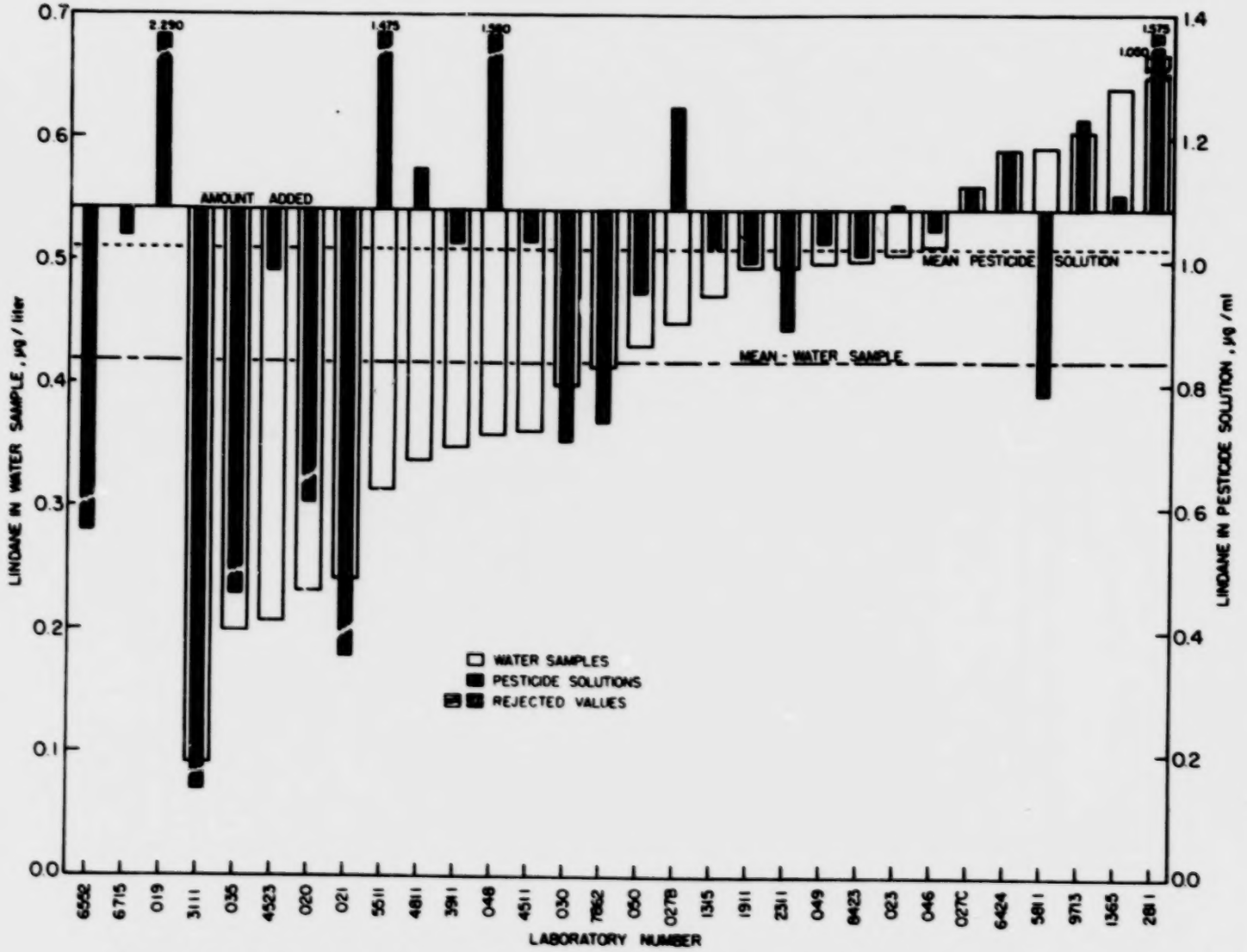


Figure 2. Bar graph for lindane in pesticide solution B and water sample B.

was no significant difference between the average assay deviation and the average extract deviation within each laboratory. The standard deviations and 50 percent range indicate that most laboratories should be able to measure lindane within ±0.1 µg/liter. The participants reported no particular difficulties with this determination.

The much greater inaccuracy of the water sample results, as shown by the relative error, indicates that extraction is more difficult than measurement by gas chromatography.

Some erroneous results may be due to interfering materials in the solvents, which produce chromatographic peaks in the same area as lindane. It is imperative that only solvents that have been redistilled in glass be used.

## HEPTACHLOR EPOXIDE

The data on heptachlor epoxide are summarized statistically in Table 2 and are presented graphically in Figures 3 and 4.

Table 2. SUMMARY OF STATISTICAL DATA FOR HEPTACHLOR EPOXIDE

| | Pesticide solution A µg/ml | Pesticide solution B µg/ml | Water sample A µg/l | Water sample B µg/l |
|---|---|---|---|---|
| Amount added | 1.022 | 1.079 | 0.511 | 0.540 |
| Mean | 1.02 | 1.11 | 0.46 | 0.50 |
| Median | 1.03 | 1.18 | 0.50 | 0.52 |
| 50% Range | ±0.13 | ±0.22 | ±0.09 | ±0.15 |
| Standard deviation | 0.42 | 0.38 | 0.18 | 0.21 |
| Relative error | 0.68 | 2.50 | 9.59 | 7.59 |
| Average assay deviation | 0.02 | 0.02 | 0.02 | 0.03 |
| Average extract deviation | ---- | ---- | 0.032 | 0.019 |
| Number of results | 28 | 28 | 25 | 28 |

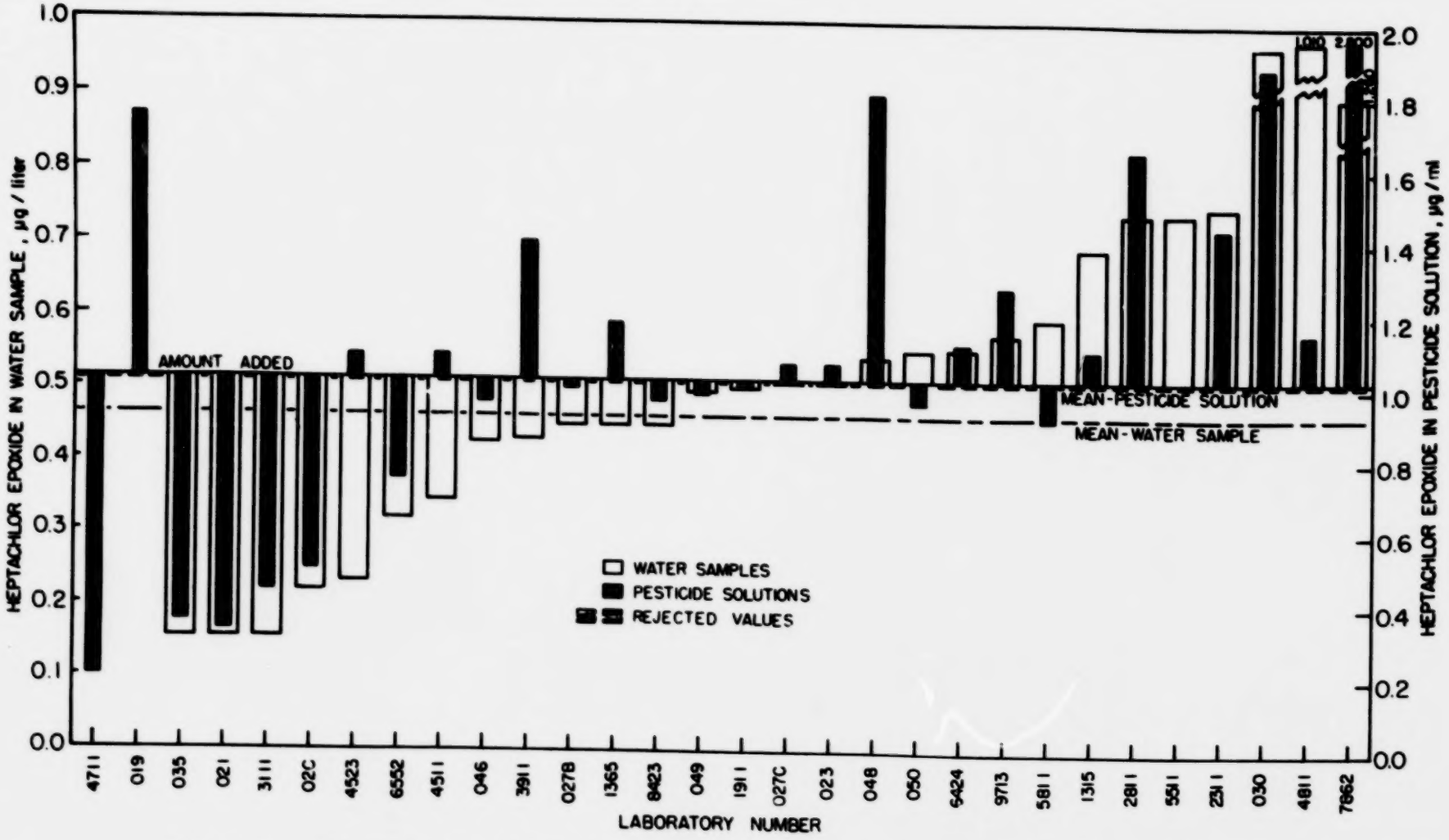


Figure 3. Bar graph for heptachlor epoxide in pesticide solution A and water sample A.

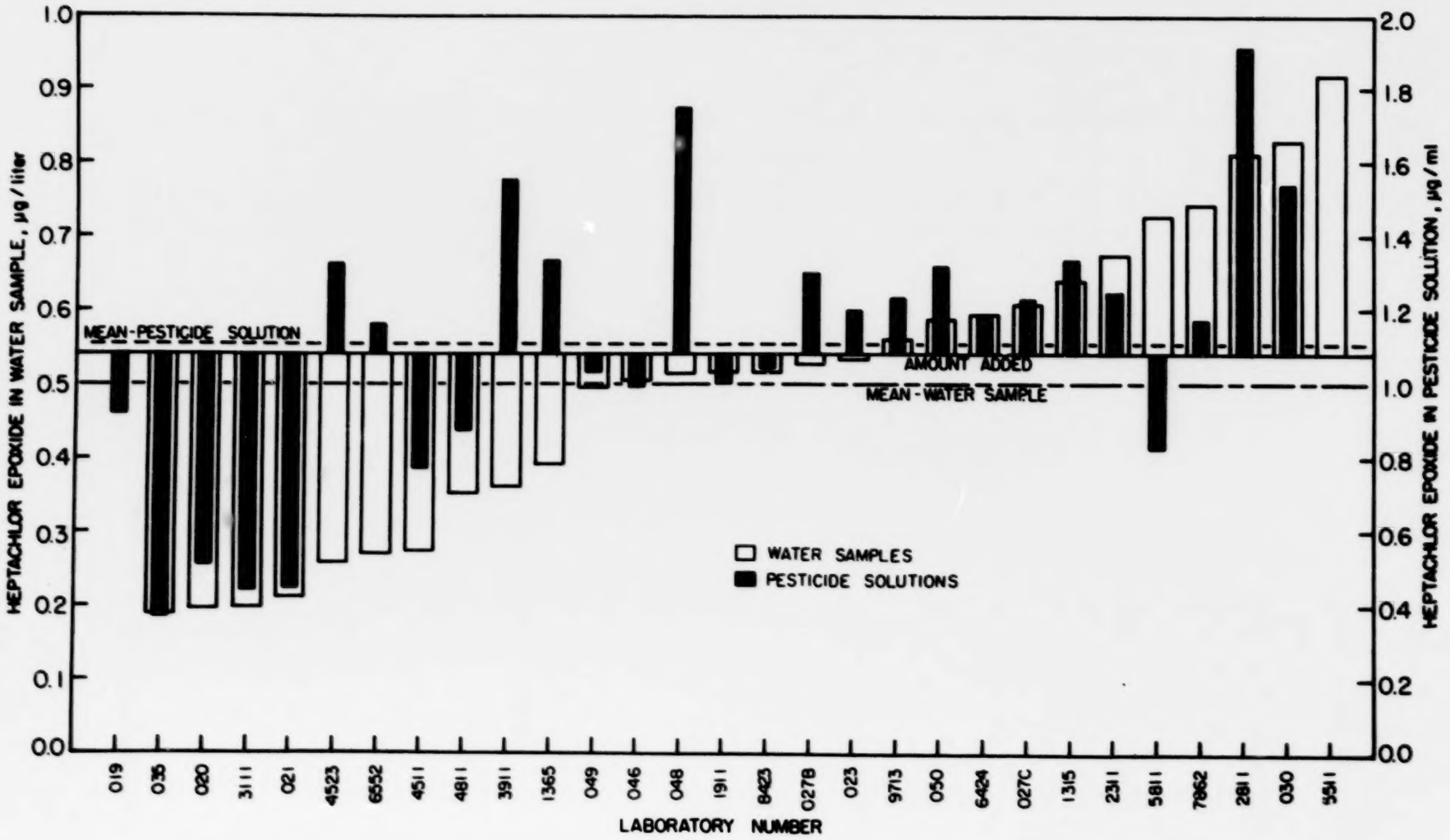


Figure 4. Bar graph for heptachlor epoxide in pesticide solution B and water sample B.

The overall accuracy of the results for heptachlor epoxide was excellent, as shown by the small relative error; the error is greater for the water samples than for the pesticide solutions. As in the case of lindane, the lower values for the water samples indicate a loss of pesticide in the extraction and failure to correct for incomplete recovery. The standard deviation shows considerable lack of precision in the pesticide solution results, whereas the water sample values are twice as precise. In cases where a polar chromatographic column was used without additional cleanup of the sample, some interference from DDE may have been encountered. There was no significant difference between the average assay deviation and the average extract deviation within each laboratory. The greatest variability was between laboratories. It was impossible for statistical evaluation to group the results according to method because too many variables were involved. In general, the most inaccurate results were obtained by the participants who used a single-column packing and did not employ a florisil column for prior separation of the pesticides.

The standard deviation and 50 percent range indicate that most laboratories should be able to measure heptachlor epoxide within $\pm 0.2$ µg/liter.

DDE

Table 3 summarizes statistical data on DDE, and Figures 5 and 6 present the data graphically.

Table 3. SUMMARY OF STATISTICAL DATA FOR DDE

| | Pesticide solution A µg/ml | Pesticide solution B µg/ml | Water sample A µg/l | Water sample B µg/l |
|---|---|---|---|---|
| Amount added | 0.755 | 1.510 | 0.378 | 0.755 |
| Mean | 0.87 | 1.51 | 0.45 | 0.68 |
| Median | 0.77 | 1.60 | 0.41 | 0.67 |
| 50% Range | ±0.14 | ±0.26 | ±0.09 | ±0.14 |
| Standard deviation | 0.38 | 0.36 | 0.19 | 0.18 |
| Relative error | 14.83 | 0.26 | 19.31 | 10.20 |
| Average assay deviation | 0.04 | 0.04 | 0.02 | 0.03 |
| Average extract deviation | ---- | ---- | 0.02 | 0.04 |
| Number of results | 23 | 23 | 24 | 24 |

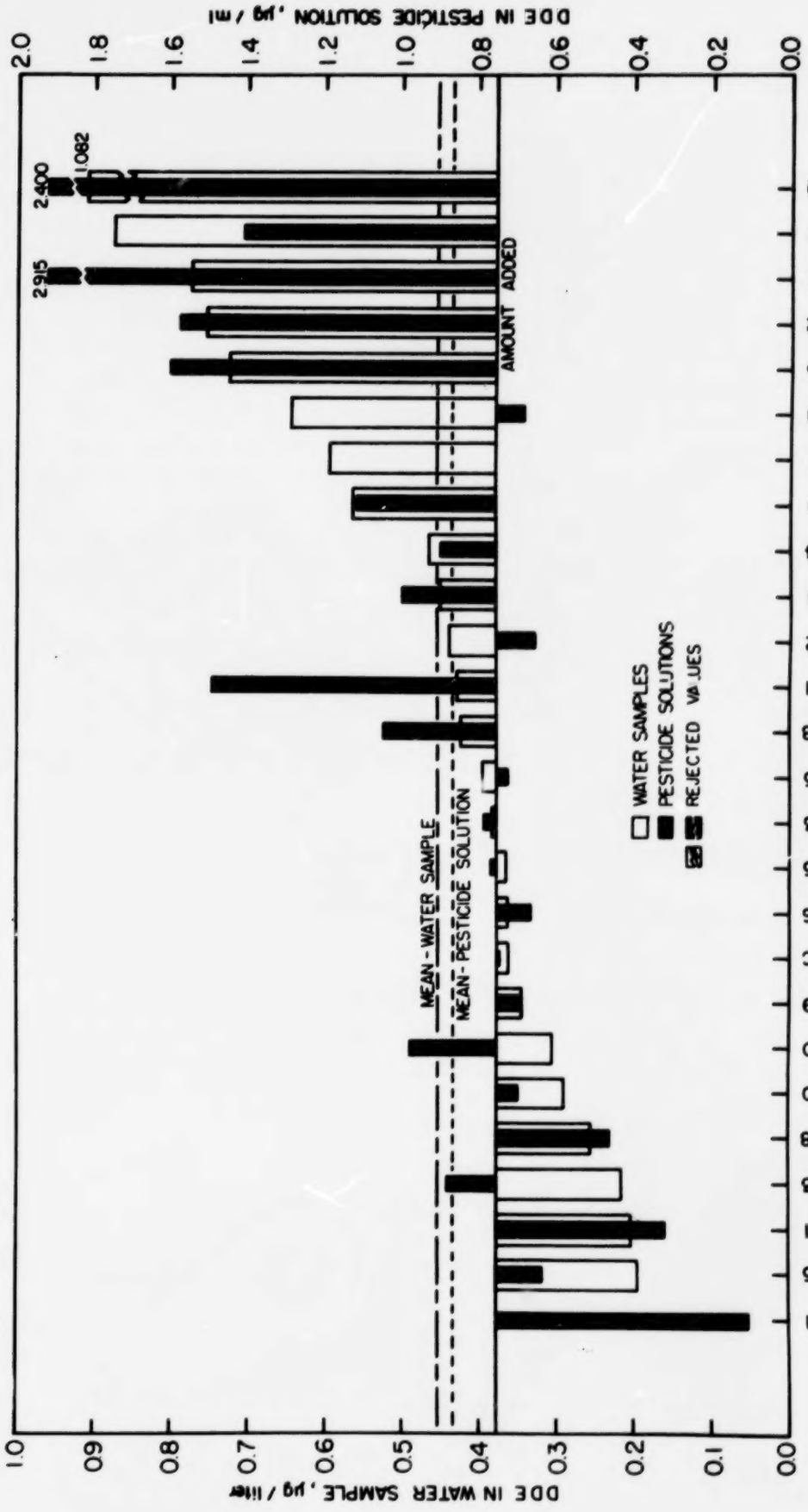


Figure 5. Bar graph for DDE in pesticide solution A and water sample A.

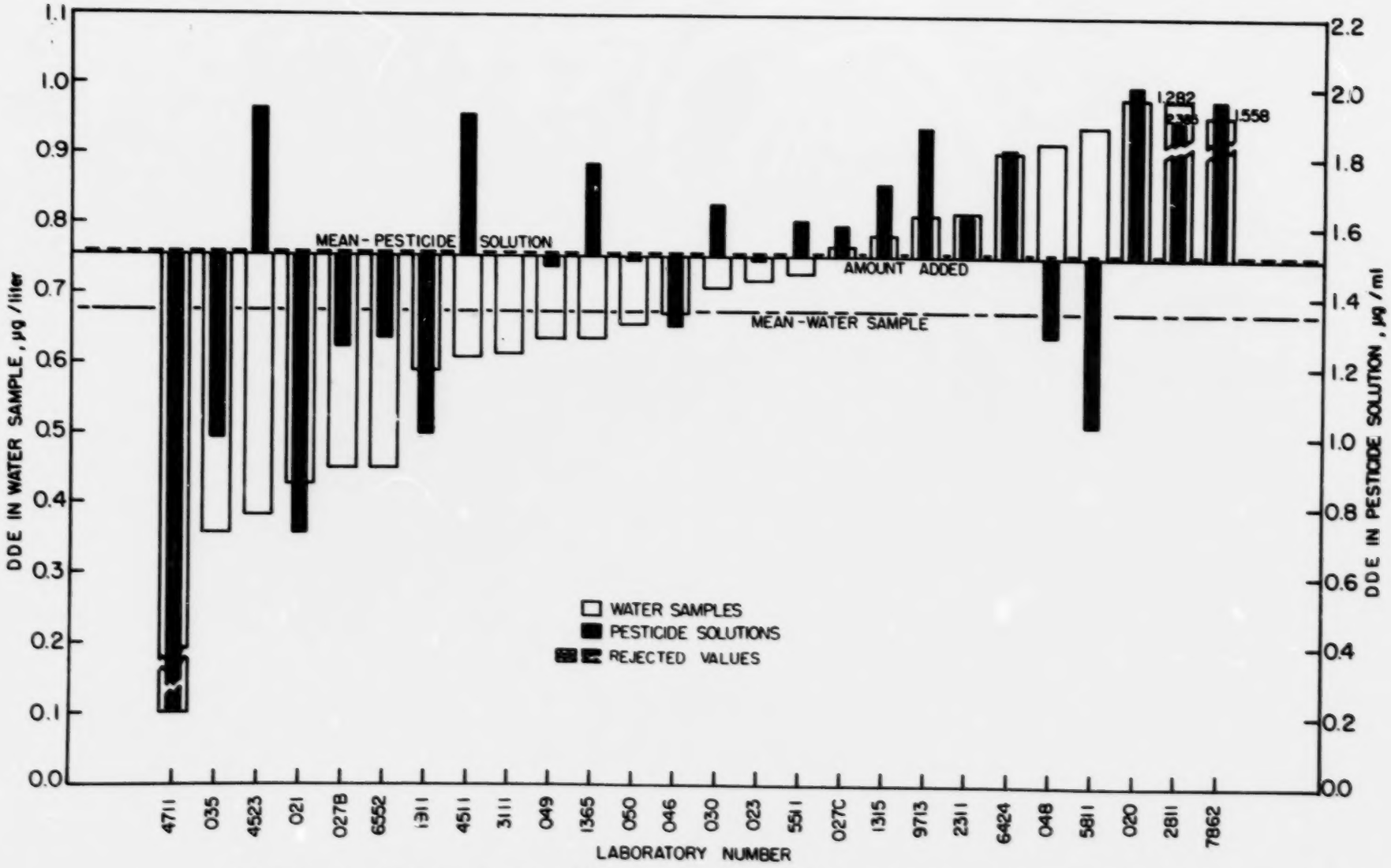


Figure 6. Bar graph for DDE in pesticide solution B and water sample B.

The overall accuracy (as determined by the means) of the DDE measurements was excellent for pesticide solution B, but was low for water sample B. For both pesticide solution A and water sample A the means were high, possibly due to interference from dieldrin in solution A which was present at a concentration twice that of DDE. In solution B, dieldrin was present at a concentration half that of DDE and apparently provided little interference. The precision as shown by the standard deviation was considerably better for the water samples than for the respective pesticide solutions. The relative error for water sample A was the greatest of the four samples, but the 50 percent range was the smallest, which indicates that the better half of the results for water sample A was quite accurate. There was no significant difference between the average assay deviation and the average extract deviation within each laboratory. In general, the best results were submitted by participants who used a polar or mixed chromatograph column. Most laboratories should be able to measure DDE within $\pm$0.2 µg/liter.

## DIELDRIN

The statistical data for dieldrin are summarized in Table 4; graphic presentation is made in Figures 7 and 8.

Table 4. SUMMARY OF STATISTICAL DATA FOR DIELDRIN

| | Pesticide solution A µg/ml | Pesticide solution B µg/ml | Water sample A µg/l | Water sample B µg/l |
|---|---|---|---|---|
| Amount added | 1.552 | 0.720 | 0.776 | 0.360 |
| Mean | 1.54 | 0.74 | 0.65 | 0.30 |
| 50% Range | 0.23 | 0.16 | 0.18 | 0.07 |
| Standard deviation | 0.43 | 0.32 | 0.30 | 0.12 |
| Relative error | 0.84 | 2.36 | 15.98 | 17.22 |
| Average assay deviation | 0.04 | 0.04 | 0.02 | 0.01 |
| Average extract deviation | ---- | ---- | 0.06 | 0.03 |
| Number of results | 24 | 24 | 27 | 23 |

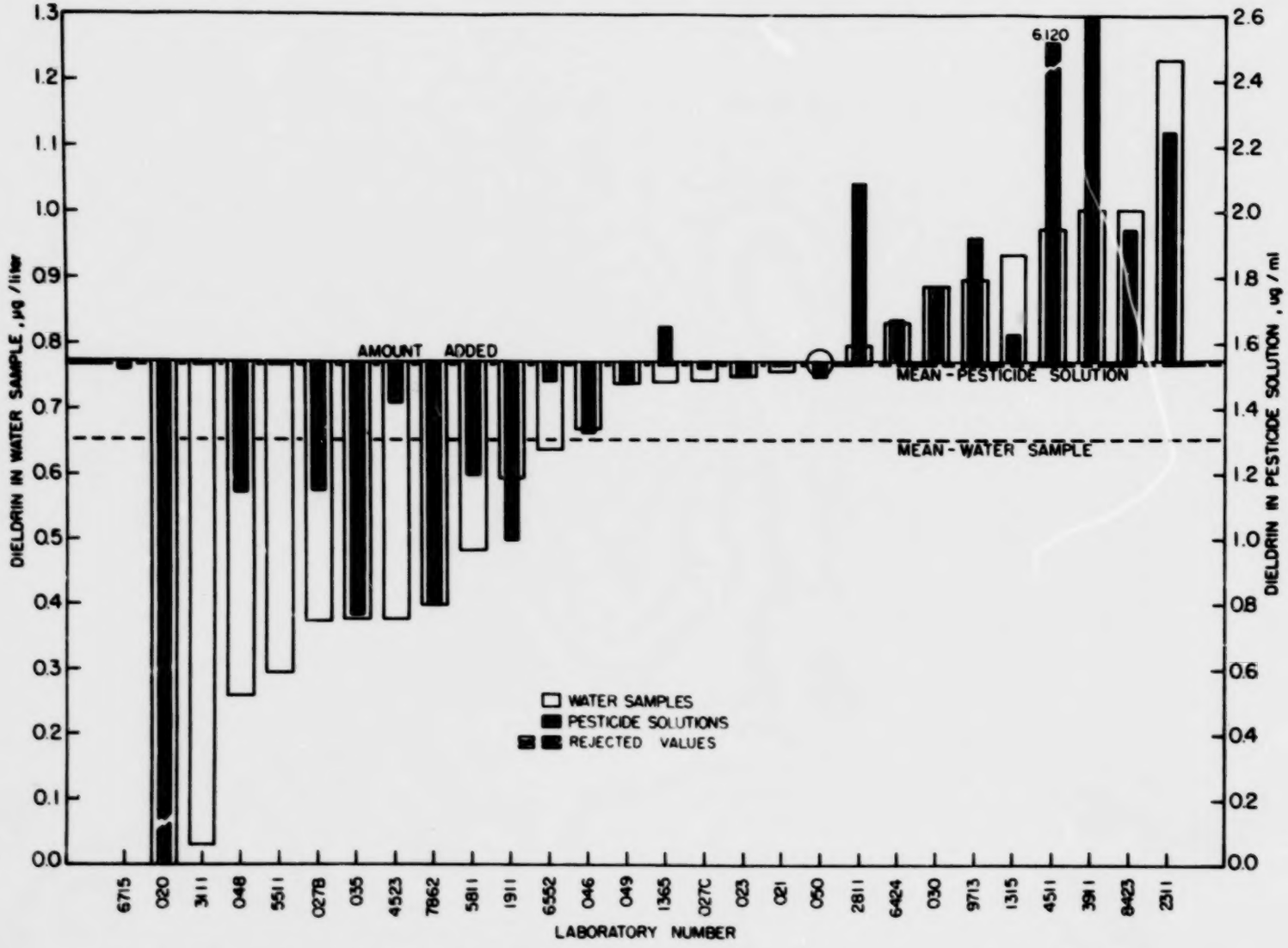


Figure 7. Bar graph for dieldrin in pesticide solution A and water sample A.

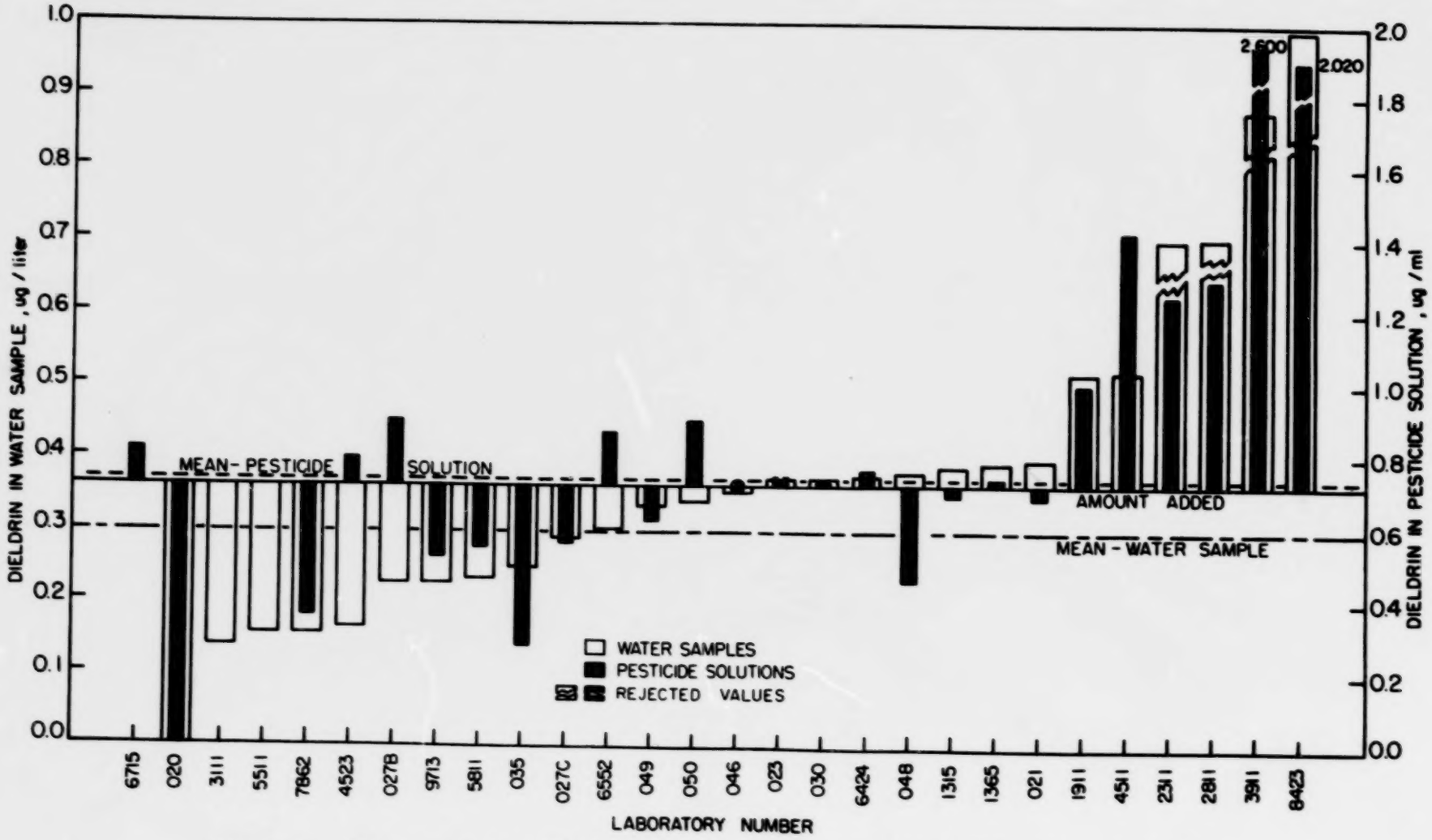


Figure 8. Bar graph for dieldrin in pesticide solution B and water sample B.

The overall accuracy (as determined by the means) of the dieldrin measurements was excellent for the pesticide solutions, but low for the water samples. On the other hand, the precision (as determined by the average assay deviation) was considerably better on the water samples. Also, the 50 percent range shows that the better half of the results for corresponding samples was more accurate for the water samples than for the corresponding pesticide solutions. The general tendency toward low results for the water samples again suggests a loss in the extraction procedure. Although the overall means show a smaller relative error for both pesticide solution A and water sample A, the 50 percent range shows that the better half of the results in each case was more accurate for pesticide solution B and water sample B. This apparent anomaly may be due to the degree of separation achieved between DDE and dieldrin. The participants within the 50 percent range probably achieved good separation and consequently better accuracy, whereas the participants who failed to separate completely the two pesticides produced grossly erroneous results that greatly affected the overall mean. Of the best 50 percent of the results, only one was obtained with a microcoulometer and the rest were measured with an electron capture detector. In this same group, all but two used either a mixed column or a nonpolar packing in conjunction with a separation of DDE and dieldrin by use of a florisil column. The other two participants in this group used a single polar material; one used QF-1 and the other used Epikote. In general, the participants that used a single nonpolar column and did not perform a separation step such as the use of a florisil column or thin-layer chromatography obtained inaccurate results.

Most laboratories should be able to measure dieldrin within $\pm 0.2$ µg/liter.

## COMMENTS OF THE PARTICIPANTS

The following comments were received from individual participants:

Difficulty was experienced in eluting dieldrin from florisil; satisfactory recovery was achieved, however, when a second eluting solution of 20 percent (rather than 15 percent) ethyl ether in hexane was used; this was preceded, of course, by a 6 percent solution to elute the other pesticides.

The concentrations of pesticides in the water samples were found to be too low for analysis with a microcoulometer; the pesticide solutions were barely within the sensitivity of the instrument.

Low recoveries were noted from thin-layer chromatography separation and Kuderna-Danish evaporation.

Microcoulometry allowed for correction factors to be applied to raw data to compensate for pesticide losses in the extraction process and chromatographic system.

One participant erroneously thought that the sample solutions contained acetone, which is not recommended for use in an electron capture gas chromatograph. Therefore, he evaporated the solutions to dryness and redissolved the residue in petroleum ether, probably incurring some loss of pesticides in the process.

When paper chromatography was used, the pesticides were discernible, but difficult to measure.

DDE and dieldrin could not be separated on a 5 percent Dow-11 column.

With a 3.8 percent SE-30 column, separation of DDE and dieldrin was not sufficient for estimation.

DDE and dieldrin were not completely resolved with a 1 percent Epikote "1001" column; however, reasonably accurate estimation was possible.

The limit detected with a microcoulometer was above 50 nanograms for this group of pesticides. The participant also commented that a DC-200 column would not resolve DDE and dieldrin, and that a QF-1 column would not resolve heptachlor epoxide and DDE; furthermore, enough residue was present in the redistilled solvents to produce peaks in the chromatogram that coincided with the pesticides in question.

## SUMMARY AND CONCLUSIONS

In general, it was found that a gas chromatographic column containing QF-1 only as the liquid phase will not effectively resolve DDE and heptachlor epoxide, and nonpolar packings such as SE-30, Dow-11 or DC-200 will not resolve the peaks of DDE and dieldrin. Several participants obtained satisfactory results with a nonpolar column by first passing the sample extract through a florisil or alumina column and then eluting the pesticides from the column with solutions of different concentrations. Of the 11 labs using a column packed with a mixture of polar and nonpolar material, 9 were in the more accurate half of the participants, if all determinations are considered.

Only solvents that have been redistilled in glass should be used, as impurities produce peaks that interfere with the pesticide peaks,

particularly the lindane peak. Generally, within a laboratory, agreement was close between duplicate extracts and duplicate assays of each extract. The greatest deviations occurred between laboratories.

Many participants apparently failed to correct for incomplete recovery of pesticide after extraction of the water sample.

With proper care and technique, most laboratories should be able to measure lindane within $\pm 0.1$ µg/l, and heptachlor epoxide, DDE, and dieldrin within $\pm 0.2$ µg/l.

The only instrumental technique with sufficient senstitivity to measure pesticides at such low concentrations is gas chromatography. The electron capture detector used by most of the participants is the most sensitive of the detection systems presently available. The newer model C-200 Dohrmann microcoulometer, however, is more sensitive than the earlier C-100 model and is capable of good accuracy at the concentrations used in the sample. The lower sensitivity and greater specificity make the microcoulometer less subject to interferences than the electron capture detector, especially when large volumes of solvent are concentrated. The results of two of the four laboratories using the microcoulometric detector were in the most accurate half of the total results.

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# APPENDICES

## APPENDIX A.

Table A-1. A SUMMARY OF THE METHODS OF DETECTION, EXTRACTION, AND SEPARATION USED BY THE PARTICIPANTS

| Lab. No. | Extraction solvent | Prior separation method | Chromatograph column | Detection method | Reference | In most accurate half |
|---|---|---|---|---|---|---|
| 019 | | | SE-30 | EC | | |
| 020 | | | 1% SE-30 | EC | 1 | |
| 021 | pet. ether | florisil | 5% Dow-11 | EC | | |
| 023 | hexane | florisil | 5% QF-1 + 10% DC-200 | EC | | X |
| 027B | benzene | | 20% DC-200 | MC | | X |
| 027C | hexane | | 3/4-5% QF-1 + 1/4-5% SE-30 | EC | | X |
| 030 | hexane | | 3% QF-1 + 1% EPON | EC | | X |
| 035 | methylene chloride + pet. ether | florisil | 5% Dow-11 | EC | 2 | |
| 046 | hexane | | 6% QF-1 + 4% SE-30 | EC | 3 | X |
| 048 | hexane | thin-layer | 5% DC-200 | MC | 3, 4 | |

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(Table A-1 continued)

| Lab. No. | Extraction solvent | Prior separation method | Chromatograph column | Detection method | Reference | In most accurate half |
|---|---|---|---|---|---|---|
| 049 | hexane | alumina | 5% Dow-11 | EC | | X |
| 050 | hexane + ether | | 6% QF-1 + 4% SE-30 | MC | | X |
| 1315 | hexane | | 4.75% QF-1 | EC | 5 | X |
| 1365 | hexane | | 3% SE-30 + 7% QF-1 | EC | 5 | X |
| 1911 | pet. ether | florisil | Dow-11 | EC | 3 | X |
| 2311 | | | 5% SE-30 + QF-1 | EC | 1, 6 | X |
| 2811 | ether + pet. ether | | 5% Dow-11 + 5% QF-1 | EC | 4 | |
| 3111 | evaporated + pet. ether | florisil | 7% DC-200 | EC | 1 | |
| 3911 | hexane | | 5% Dow-11 | EC | 3 | |
| 4511 | pet. ether | | 5% QF-1 | EC | 7 | |
| 4523 | hexane + ether | | 1:1-5% QF-1 + 5% DC-200 | EC | | |

(Table A-1 continued)

| Lab. No. | Extraction solvent | Prior separation method | Chromatograph column | Detection method | Reference | In most accurate half |
|---|---|---|---|---|---|---|
| 4711 | | | paper chromatography | | 1, 6, 8 | |
| 4811 | benzene | | 5% Dow-11 | EC | | |
| 5511 | methylene chloride + pet. ether | florisil | 3.8% SE-30 | EC | 2 | |
| 5811 | hexane | | 5% QF-1 + 5% Dow-11 (used separately) | EC | | |
| 6424 | pet. ether | | 1% EPIKOTE "1001" | EC | | X |
| 6552 | acetonitrile | | 3/4-5% Dow-11 + 1/4-3% QF-1 | EC | 9 | X |
| 6715 | ether + pet. ether | | 5% DC-200 | MC | 4 | |
| 7862 | | | 5% DC-200 | EC | 1 | |
| 8423 | | | 5% Dow-11 + 5% QF-1 | EC | | X |
| 9713 | | thin-layer | 5% Dow-11 | EC | 1 | X |

Table A-2. TABULATION OF RESULTS FOR LINDANE

| Lab. No. | Pesticide solution A 1.017 µg/ml | | | Water sample A 0.508 µg/l | | | | | Pesticide solution B 1.085 µg/ml | | | Water sample B 0.542 µg/l | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Results | Assay mean | Assay average deviation | Results | Assay mean | Assay average deviation | Extract mean | Extract average deviation | Results | Assay mean | Assay average deviation | Results | Assay mean | Assay average deviation | Extract mean | Extract average deviation |
| 019 | 1.26 | 1.28 | ----- | ---- | ----- | ----- | ----- | ----- | 2.29 | 2.29 | ----- | ---- | ----- | ----- | ---- | ----- |
| | ---- | | | ---- | | | | | ---- | | | ---- | | | | |
| | | | | ---- | ----- | ----- | | | | | | ---- | ----- | ----- | | |
| | | | | ---- | | | | | | | | ---- | | | | |
| 020 | 0.60 | 0.605 | 0.005 | 0.26 | 0.235 | 0.025 | | | 0.60 | 0.610 | 0.010 | 0.20 | 0.230 | 0.030 | | |
| | 0.61 | | | 0.21 | | | 0.228 | 0.008 | 0.62 | | | 0.26 | | | 0.232 | 0.002 |
| | | | | 0.23 | 0.220 | 0.010 | | | | | | 0.21 | 0.235 | 0.025 | | |
| | | | | 0.21 | | | | | | | | 0.26 | | | | |
| 021 | 0.39 | 0.385 | 0.005 | 0.146 | 0.146 | 0.000 | | | 0.35 | 0.360 | 0.010 | 0.240 | 0.232 | 0.008 | | |
| | 0.38 | | | 0.146 | | | 0.144 | 0.002 | 0.37 | | | 0.224 | | | 0.242 | 0.010 |
| | | | | 0.138 | 0.142 | 0.004 | | | | | | 0.242 | 0.251 | 0.009 | | |
| | | | | 0.146 | | | | | | | | 0.260 | | | | |
| 023 | 1.04 | 1.030 | 0.010 | 0.46 | 0.465 | 0.005 | | | 1.10 | 1.090 | 0.010 | 0.51 | 0.510 | 0.000 | | |
| | 1.02 | | | 0.47 | | | 0.470 | 0.005 | 1.08 | | | 0.51 | | | 0.505 | 0.005 |
| | | | | 0.47 | 0.475 | 0.005 | | | | | | 0.50 | 0.500 | 0.000 | | |
| | | | | 0.48 | | | | | | | | 0.50 | | | | |
| 027B | 1.10 | 1.050 | 0.050 | 0.40 | 0.450 | 0.050 | | | 1.20 | 1.250 | 0.050 | 0.50 | 0.450 | 0.050 | | |
| | 1.00 | | | 0.50 | | | 0.425 | 0.025 | 1.30 | | | 0.40 | | | 0.450 | 0.000 |
| | | | | 0.40 | 0.400 | 0.000 | | | | | | 0.40 | 0.450 | 0.050 | | |
| | | | | 0.40 | | | | | | | | 0.50 | | | | |
| 027C | 1.07 | 1.070 | 0.000 | 0.53 | 0.530 | 0.000 | | | 1.12 | 1.120 | 0.000 | 0.56 | 0.565 | 0.005 | | |
| | 1.07 | | | 0.53 | | | 0.512 | 0.018 | 1.12 | | | 0.57 | | | 0.560 | 0.005 |
| | | | | 0.50 | 0.495 | 0.005 | | | | | | 0.56 | 0.555 | 0.005 | | |
| | | | | 0.49 | | | | | | | | 0.55 | | | | |
| 030 | 1.22 | 1.22 | 0.000 | 0.56 | 0.560 | ----- | | | 0.72 | 0.710 | 0.010 | 0.41 | 0.400 | 0.010 | | |
| | ---- | | | ---- | | | 0.590 | 0.030 | 0.70 | | | 0.39 | | | 0.400 | 0.000 |
| | | | | 0.62 | 0.620 | ----- | | | | | | 0.34 | 0.400 | 0.060 | | |
| | | | | ---- | | | | | | | | 0.46 | | | | |
| 035 | 0.37 | 0.390 | 0.020 | 0.23 | 0.285 | 0.055 | | | 0.44 | 0.460 | 0.020 | 0.16 | 0.200 | 0.040 | | |
| | 0.41 | | | 0.34 | | | 0.258 | 0.028 | 0.48 | | | 0.24 | | | 0.200 | 0.000 |
| | | | | 0.12 | 0.230 | 0.110 | | | | | | 0.12 | 0.200 | 0.080 | | |
| | | | | 0.34 | | | | | | | | 0.28 | | | | |

(Table A-2 continued)

| Lab. No. | Pesticide solution A 1.017 µg/ml | | | Water sample A 0.508 µg/l | | | | | Pesticide solution B 1.085 µg/ml | | | Water sample B 0.542 µg/l | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Results | Assay mean | Assay average deviation | Results | Assay mean | Assay average deviation | Extract mean | Extract average deviation | Results | Assay mean | Assay average deviation | Results | Assay mean | Assay average deviation | Extract mean | Extract average deviation |
| 046 | 0.94<br>1.03 | 0.985 | 0.045 | 0.46<br>0.46<br>0.44<br>0.46 | 0.460<br>0.450 | 0.000<br>0.010 | 0.455 | 0.005 | 0.97<br>1.13 | 1.050 | 0.080 | 0.50<br>0.51<br>0.52<br>0.52 | 0.505<br>0.520 | 0.005<br>0.000 | 0.512 | 0.008 |
| 048 | 1.84<br>1.69 | 1.765 | 0.075 | 0.14<br>0.15<br>0.33<br>0.29 | 0.145<br>0.310 | 0.005<br>0.020 | 0.228 | 0.082 | 1.84<br>1.32 | 1.580 | 0.260 | 0.35<br>0.35<br>0.37<br>0.37 | 0.350<br>0.370 | 0.000<br>0.000 | 0.360 | 0.010 |
| 049 | 1.00<br>0.99 | 0.995 | 0.005 | 0.48<br>0.49<br>0.48<br>0.49 | 0.485<br>0.485 | 0.005<br>0.005 | 0.485 | 0.000 | 1.02<br>1.04 | 1.03 | 0.010 | 0.52<br>0.51<br>0.48<br>0.48 | 0.515<br>0.480 | 0.005<br>0.000 | 0.498 | 0.018 |
| 050 | 0.97<br>0.79 | 0.880 | 0.080 | 0.39<br>0.39<br>0.46<br>0.35 | 0.390<br>0.405 | 0.000<br>0.055 | 0.398 | 0.008 | 1.26<br>0.64 | 0.950 | 0.310 | 0.48<br>0.41<br>0.51<br>0.33 | 0.445<br>0.420 | 0.035<br>0.090 | 0.432 | 0.012 |
| 1315 | 0.98<br>1.09 | 1.035 | 0.055 | 0.54<br>0.58<br>0.54<br>0.55 | 0.560<br>0.545 | 0.020<br>0.005 | 0.552 | 0.008 | 1.10<br>0.95 | 1.025 | 0.075 | 0.45<br>0.48<br>0.48<br>0.48 | 0.465<br>0.480 | 0.015<br>0.000 | 0.472 | 0.008 |
| 1365 | 0.98<br>1.02 | 1.000 | 0.002 | 0.51<br>0.49<br>0.62<br>0.65 | 0.500<br>0.635 | 0.010<br>0.015 | 0.568 | 0.068 | 1.10<br>1.11 | 1.105 | 0.005 | 0.61<br>0.63<br>0.67<br>0.65 | 0.620<br>0.660 | 0.010<br>0.010 | 0.640 | 0.020 |
| 1911 | 1.00<br>1.00 | 1.000 | 0.000 | 0.51<br>0.50<br>0.50<br>0.50 | 0.505<br>0.500 | 0.005<br>0.000 | 0.502 | 0.002 | 1.00<br>1.00 | 1.00 | 0.000 | 0.50<br>0.50<br>0.48<br>0.50 | 0.500<br>0.490 | 0.000<br>0.010 | 0.495 | 0.005 |
| 2311 | 1.09<br>1.02 | 1.055 | 0.035 | 0.54<br>0.55<br>0.53<br>0.55 | 0.545<br>0.540 | 0.005<br>0.010 | 0.542 | 0.002 | 0.90<br>0.88 | 0.890 | 0.010 | 0.44<br>0.44<br>0.525<br>0.575 | 0.440<br>0.550 | 0.000<br>0.025 | 0.495 | 0.055 |

(Table A-2 continued)

| Lab. No. | Pesticide solution A 1.017 µg/ml | | | Water sample A 0.508 µg/l | | | | | Pesticide solution B 1.085 µg/ml | | | | Water sample B 0.542 µg/l | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Results | Assay mean | Assay average deviation | Results | Assay mean | Assay average deviation | Extract mean | Extract average deviation | Results | Assay mean | Assay average deviation | Results | Assay mean | Assay average deviation | Extract mean | Extract average deviation |
| 2811 | 1.25<br>1.10 | 1.175 | 0.075 | 0.67<br>0.63<br>----<br>---- | 0.645 | 0.025<br>----- | 0.645 | ----- | 1.60<br>1.55 | 1.575 | 0.025 | 1.20<br>1.00<br>1.00<br>1.00 | 1.100<br>1.000 | 0.100<br>0.000 | 1.050 | 0.050 |
| 3111 | 0.18<br>0.19 | 0.185 | 0.005 | 0.09<br>0.12<br>0.09<br>0.09 | 0.105<br>0.090 | 0.015<br>0.000 | 0.098 | 0.008 | 0.14<br>0.14 | 0.140 | 0.000 | 0.11<br>0.10<br>0.08<br>0.08 | 0.105<br>0.080 | 0.005<br>0.000 | 0.092 | 0.012 |
| 3911 | 1.03<br>1.02 | 1.025 | 0.005 | 0.34<br>0.33<br>0.32<br>0.31 | 0.335<br>0.315 | 0.005<br>0.005 | 0.325 | 0.010 | 1.03<br>1.03 | 1.030 | 0.000 | 0.38<br>0.37<br>0.30<br>0.35 | 0.375<br>0.325 | 0.005<br>0.025 | 0.350 | 0.025 |
| 4511 | 3.84<br>3.49 | 3.165 | 0.325 | 0.80<br>----<br>0.40<br>---- | 0.80<br>0.40 | -----<br>----- | 0.600 | 0.200 | 1.09<br>0.98 | 1.035 | 0.055 | 0.30<br>0.29<br>0.43<br>---- | 0.295<br>0.430 | 0.005<br>----- | 0.362 | 0.068 |
| 4523 | 0.94<br>0.92 | 0.930 | 0.010 | 0.18<br>0.17<br>0.17<br>0.17 | 0.175<br>0.170 | 0.005<br>0.000 | 0.172 | 0.002 | 1.00<br>0.97 | 0.985 | 0.015 | 0.18<br>0.20<br>0.25<br>0.20 | 0.190<br>0.225 | 0.010<br>0.025 | 0.208 | 0.018 |
| 4811 | 1.84<br>1.80 | 1.820 | 0.020 | 1.50<br>1.30<br>1.50<br>1.70 | 1.400<br>1.600 | 0.100<br>0.100 | 1.500 | 0.100 | 1.10<br>1.20 | 1.150 | 0.050 | 0.32<br>0.30<br>0.35<br>0.38 | 0.310<br>0.365 | 0.010<br>0.015 | 0.338 | 0.028 |
| 5511 | 1.40<br>1.37 | 1.385 | 0.015 | 0.36<br>----<br>0.38<br>---- | 0.36<br>0.38 | -----<br>----- | 0.370 | 0.010 | 1.48<br>1.47 | 1.475 | 0.005 | 0.32<br>----<br>0.31<br>---- | 0.32<br>0.31 | -----<br>----- | 0.315 | 0.005 |
| 5811 | 0.79<br>0.88 | 0.835 | 0.045 | 0.56<br>0.69<br>0.52<br>0.80 | 0.625<br>0.660 | 0.065<br>0.140 | 0.642 | 0.018 | 0.75<br>0.82 | 0.785 | 0.035 | 0.37<br>0.80<br>0.40<br>0.80 | 0.585<br>0.600 | 0.215<br>0.200 | 0.592 | 0.008 |

(Table A-2 continued)

| Lab. No. | Pesticide solution A 1.017 µg/ml | | | Water sample A 0.508 µg/l | | | | | Pesticide solution B 1.085 µg/ml | | | Water sample B 0.542 µg/l | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Results | Assay mean | Assay average deviation | Results | Assay mean | Assay average deviation | Extract mean | Extract average deviation | Results | Assay mean | Assay average deviation | Results | Assay mean | Assay average deviation | Extract mean | Extract average deviation |
| 6424 | 1.13<br>1.10 | 1.115 | 0.015 | 0.54<br>0.55<br>0.55<br>0.54 | 0.545 | 0.005 | 0.545 | 0.000 | 1.17<br>1.19 | 1.180 | 0.010 | 0.58<br>0.60<br>0.59<br>0.59 | 0.590 | 0.010<br><br>0.000 | 0.590 | 0.000 |
| 6552 | 0.60<br>0.50 | 0.550 | 0.050 | ----<br>----<br>----<br>---- | ----- | ----- | ----- | ----- | 0.58<br>0.54 | 0.560 | 0.020 | ----<br>----<br>----<br>---- | ----- | ----- | ----- | ----- |
| 6715 | 1.00<br>1.04 | 1.020 | 0.020 | ----<br>----<br>----<br>---- | ----- | ----- | ----- | ----- | 1.02<br>1.06 | 1.040 | 0.020 | ----<br>----<br>---<br>---- | ----- | ----- | ----- | ----- |
| 7862 | 1.24<br>1.28 | 1.260 | 0.020 | 0.60<br>0.61<br>----<br>---- | 0.605 | 0.005<br><br>----- | 0.605 | ----- | 0.70<br>0.78 | 0.740 | 0.040 | 0.35<br>0.36<br>0.50<br>0.45 | 0.355 | 0.005<br><br>0.025 | 0.415 | 0.060 |
| 8423 | 1.00<br>---- | 1.00 | ----- | 0.48<br>0.48<br>0.47<br>0.47 | 0.480<br><br>0.470 | 0.000<br><br>0.000 | 0.475 | 0.005 | 1.01<br>---- | 1.01 | ----- | 0.50<br>0.50<br>0.50<br>0.50 | 0.500<br><br>0.500 | 0.000<br><br>0.000 | 0.500 | 0.000 |
| 9713 | 1.25<br>1.20 | 1.225 | 0.025 | 0.57<br>0.54<br>----<br>---- | 0.555 | 0.015<br><br>----- | 0.555 | ----- | 1.22<br>1.24 | ..230 | 0.010 | 0.59<br>0.62<br>----<br>---- | 0.605 | 0.015<br><br>----- | 0.605 | ----- |

Table A-3. TABULATION OF RESULTS FOR HEPTACHLOR EPOXIDE

| Lab. No. | Pesticide solution A 1.022 µg/ml | | | Water sample A 0.511 µg/l | | | | | Pesticide solution B 1.079 µg/ml | | | Water sample B 0.540 µg/l | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Results | Assay mean | Assay average deviation | Results | Assay mean | Assay average deviation | Extract mean | Extract average deviation | Results | Assay mean | Assay average deviation | Results | Assay mean | Assay average deviation | Extract mean | Extract average deviation |
| 019 | 0.87<br>---- | 0.87 | ----- | ----<br>----<br>----<br>---- | -----<br>-----<br>----- | -----<br>-----<br>----- | ----- | ----- | 0.92<br>---- | 0.92 | ----- | ----<br>----<br>----<br>---- | -----<br>-----<br>----- | -----<br>-----<br>----- | ----- | ----- |
| 020 | 0.50<br>0.50 | 0.50 | 0.000 | 0.24<br>0.23<br>0.20<br>0.21 | 0.235<br>0.205 | 0.005<br>0.005 | 0.220 | 0.015 | 0.52<br>0.50 | 0.510 | 0.010 | 0.19<br>0.18<br>0.21<br>0.20 | 0.185<br>0.205 | 0.005<br>0.005 | 0.195 | 0.010 |
| 021 | 0.33<br>0.33 | 0.33 | 0.000 | 0.164<br>0.164<br>0.150<br>0.140 | 0.164<br>0.145 | 0.000<br>0.005 | 0.154 | 0.010 | 0.43<br>0.42 | 0.425 | 0.005 | 0.222<br>0.196<br>0.220<br>0.204 | 0.209<br>0.212 | 0.013<br>0.008 | 0.210 | 0.002 |
| 023 | 1.07<br>1.06 | 1.065 | 0.005 | 0.51<br>0.51<br>0.50<br>0.52 | 0.510<br>0.510 | 0.000<br>0.010 | 0.510 | 0.000 | 1.20<br>1.20 | 1.200 | 0.000 | 0.54<br>0.53<br>0.54<br>0.52 | 0.530<br>0.535 | 0.005<br>0.010 | 0.532 | 0.002 |
| 027B | 1.00<br>1.00 | 1.00 | 0.000 | 0.50<br>0.40<br>0.50<br>0.40 | 0.450<br>0.450 | 0.050<br>0.050 | 0.450 | 0.000 | 1.3<br>1.3 | 1.30 | 0.000 | 0.6<br>0.5<br>0.5<br>0.5 | 0.55<br>0.50 | 0.05<br>0.00 | 0.525 | 0.025 |
| 027C | 1.05<br>1.08 | 1.065 | 0.015 | 0.54<br>0.53<br>0.49<br>0.47 | 0.535<br>0.480 | 0.005<br>0.010 | 0.508 | 0.028 | 1.23<br>1.23 | 1.23 | 0.000 | 0.61<br>0.61<br>0.61<br>0.60 | 0.610<br>0.605 | 0.000<br>0.005 | 0.608 | 0.002 |
| 030 | 1.88<br>---- | 1.88 | ----- | 0.94<br>----<br>1.00<br>---- | 0.940<br>1.000 | -----<br>----- | 0.970 | 0.030 | 1.54<br>---- | 1.54 | ----- | 0.82<br>----<br>0.84<br>---- | 0.82<br>0.84 | -----<br>----- | 0.830 | 0.010 |
| 035 | 0.35<br>0.36 | 0.355 | 0.005 | 0.12<br>0.20<br>0.08<br>0.21 | 0.160<br>0.145 | 0.040<br>0.065 | 0.152 | 0.008 | 0.37<br>0.36 | 0.365 | 0.005 | 0.14<br>0.25<br>0.12<br>0.24 | 0.195<br>0.180 | 0.055<br>0.060 | 0.188 | 0.008 |

(Table A-3 continued)

| Lab. No. | Pesticide solution A 1.022 µg/ml | | | Water sample A 0.511 µg/l | | | | | Pesticide solution B 1.079 µg/ml | | | Water sample B 0.540 µg/l | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Results | Assay mean | Assay average deviation | Results | Assay mean | Assay average deviation | Extract mean | Extract average deviation | Results | Assay mean | Assay average deviation | Results | Assay mean | Assay average deviation | Extract mean | Extract average deviation |
| 046 | 0.92 | 0.960 | 0.040 | 0.44 | 0.440 | 0.000 | | | 0.96 | 0.990 | 0.030 | 0.51 | 0.520 | 0.010 | | |
| | 1.00 | | | 0.44 | | | 0.425 | 0.015 | 1.02 | | | 0.53 | | | 0.502 | 0.018 |
| | | | | 0.40 | 0.410 | 0.010 | | | | | | 0.49 | 0.485 | 0.005 | | |
| | | | | 0.42 | | | | | | | | 0.48 | | | | |
| 048 | 1.96 | 1.800 | 0.160 | 0.19 | 0.210 | 0.020 | | | 1.90 | 1.750 | 0.150 | 0.57 | 0.525 | 0.045 | | |
| | 1.64 | | | 0.23 | | | 0.542 | 0.332 | 1.60 | | | 0.48 | | | 0.512 | 0.012 |
| | | | | 0.90 | 0.875 | 0.025 | | | | | | 0.50 | 0.50 | 0.000 | | |
| | | | | 0.85 | | | | | | | | 0.50 | | | | |
| 049 | 0.97 | 0.985 | 0.015 | 0.48 | 0.490 | 0.010 | | | 1.02 | 1.030 | 0.010 | 0.51 | 0.51 | 0.000 | | |
| | 1.00 | | | 0.50 | | | 0.495 | 0.005 | 1.04 | | | 0.51 | | | 0.495 | 0.015 |
| | | | | 0.51 | 0.500 | 0.010 | | | | | | 0.48 | 0.48 | 0.000 | | |
| | | | | 0.49 | | | | | | | | 0.48 | | | | |
| 050 | 0.92 | 0.960 | 0.040 | 0.48 | 0.510 | 0.030 | | | 1.31 | 1.320 | 0.010 | 0.59 | 0.575 | 0.015 | | |
| | 1.00 | | | 0.54 | | | 0.552 | 0.042 | 1.33 | | | 0.56 | | | 0.588 | 0.013 |
| | | | | 0.66 | 0.595 | 0.065 | | | | | | 0.73 | 0.600 | 0.130 | | |
| | | | | 0.53 | | | | | | | | 0.47 | | | | |
| 1315 | 1.09 | 1.105 | 0.015 | 0.70 | 0.685 | 0.015 | | | 1.31 | 1.335 | 0.025 | 0.67 | 0.630 | 0.040 | | |
| | 1.12 | | | 0.67 | | | 0.692 | 0.008 | 1.36 | | | 0.59 | | | 0.640 | 0.010 |
| | | | | 0.71 | 0.700 | 0.010 | | | | | | 0.61 | 0.650 | 0.040 | | |
| | | | | 0.69 | | | | | | | | 0.69 | | | | |
| 1365 | 1.16 | 1.180 | 0.020 | 0.44 | 0.455 | 0.015 | | | 1.33 | 1.335 | 0.005 | 0.40 | 0.395 | 0.005 | | |
| | 1.20 | | | 0.47 | | | 0.450 | 0.005 | 1.34 | | | 0.39 | | | 0.390 | 0.005 |
| | | | | 0.48 | 0.445 | 0.035 | | | | | | 0.39 | 0.385 | 0.005 | | |
| | | | | 0.41 | | | | | | | | 0.38 | | | | |
| 1911 | 1.00 | 1.00 | 0.000 | 0.53 | 0.515 | 0.015 | | | 1.00 | 1.00 | 0.000 | 0.57 | 0.535 | 0.035 | | |
| | 1.00 | | | 0.60 | | | 0.500 | 0.015 | 1.00 | | | 0.50 | | | 0.515 | 0.020 |
| | | | | 0.47 | 0.485 | 0.015 | | | | | | 0.47 | 0.495 | 0.025 | | |
| | | | | 0.50 | | | | | | | | 0.52 | | | | |
| 2311 | 1.42 | 1.435 | 0.015 | 0.750 | 0.751 | 0.001 | | | 1.25 | 1.245 | 0.005 | 0.650 | 0.655 | 0.005 | | |
| | 1.45 | | | 0.752 | | | 0.750 | 0.000 | 1.24 | | | 0.660 | | | 0.675 | 0.020 |
| | | | | 0.750 | 0.750 | 0.000 | | | | | | 0.700 | 0.695 | 0.005 | | |
| | | | | 0.750 | | | | | | | | 0.690 | | | | |

(Table A-3 continued)

| Lab. No. | Pesticide solution A 1.022 µg/ml | | | Water sample A 0.511 µg/l | | | | | Pesticide solution B 1.079 µg/ml | | | Water sample B 0.540 µg/l | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Results | Assay mean | Assay average deviation | Results | Assay mean | Assay average deviation | Extract mean | Extract average deviation | Results | Assay mean | Assay average deviation | Results | Assay mean | Assay average deviation | Extract mean | Extract average deviation |
| 3811 | 1.70<br>1.60 | 1.65 | 0.050 | 0.75<br>0.73<br>----<br>---- | 0.740 | 0.010<br>-----<br>----- | 0.740 | ----- | 1.93<br>1.90 | 1.915 | 0.015 | 0.80<br>0.76<br>0.85<br>0.84 | 0.780<br>0.845 | 0.020<br>0.005 | 0.812 | 0.032 |
| 3111 | 0.44<br>0.44 | 0.440 | 0.000 | 0.14<br>0.16<br>0.16<br>0.16 | 0.150<br>0.160 | 0.010<br>0.000 | 0.155 | 0.005 | 0.41<br>0.47 | 0.440 | 0.030 | 0.21<br>0.21<br>0.19<br>0.18 | 0.210<br>0.185 | 0.000<br>0.005 | 0.198 | 0.012 |
| 3911 | 1.40<br>1.40 | 1.400 | 0.000 | 0.46<br>0.44<br>0.44<br>0.38 | 0.450<br>0.410 | 0.010<br>0.030 | 0.430 | 0.020 | 1.54<br>1.56 | 1.550 | 0.010 | 0.44<br>0.35<br>0.26<br>0.39 | 0.395<br>0.325 | 0.045<br>0.065 | 0.360 | 0.035 |
| 4511 | 1.09<br>1.09 | 1.090 | 0.000 | 0.37<br>0.37<br>0.35<br>0.29 | 0.370<br>0.320 | 0.000<br>0.030 | 0.345 | 0.025 | 0.74<br>0.80 | 0.770 | 0.030 | 0.20<br>----<br>0.33<br>0.36 | 0.200<br>0.345 | -----<br>0.015 | 0.272 | 0.072 |
| 4523 | 1.11<br>1.06 | 1.085 | 0.025 | 0.24<br>0.24<br>0.21<br>0.24 | 0.240<br>0.225 | 0.000<br>0.015 | 0.232 | 0.007 | 1.35<br>1.30 | 1.325 | 0.025 | 0.23<br>0.26<br>0.28<br>0.26 | 0.245<br>0.270 | 0.015<br>0.010 | 0.258 | 0.013 |
| 4711 | 0.10<br>0.10 | 0.100 | 0.000 | ----<br>----<br>----<br>---- | -----<br>----- | -----<br>----- | ----- | ----- | ----<br>---- | ----- | ----- | ----<br>----<br>----<br>---- | -----<br>----- | -----<br>----- | ----- | ----- |
| 4811 | 1.16<br>1.15 | 1.155 | 0.005 | 0.98<br>1.00<br>0.95<br>1.14 | 0.975<br>1.045 | 0.025<br>0.085 | 1.010 | 0.035 | 0.85<br>0.90 | 0.875 | 0.025 | 0.36<br>0.34<br>0.33<br>0.37 | 0.350<br>0.350 | 0.010<br>0.020 | 0.350 | 0.000 |
| 5811 | ----<br>---- | ----- | ----- | 0.70<br>----<br>0.78<br>---- | 0.70<br>0.78 | -----<br>----- | 0.740 | 0.040 | ----<br>---- | ----- | ----- | 0.92<br>----<br>0.92<br>---- | 0.92<br>0.92 | -----<br>----- | 0.920 | 0.000 |

(Table A-3 continued)

| Lab. No. | Pesticide solution A 1.022 µg/ml | | | Water sample A 0.511 µg/l | | | | | Pesticide solution B 1.079 µg/ml | | | Water sample B 0.540 µg/l | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Results | Assay mean | Assay average deviation | Results | Assay mean | Assay average deviation | Extract mean | Extract average deviation | Results | Assay mean | Assay average deviation | Results | Assay mean | Assay average deviation | Extract mean | Extract average deviation |
| 5811 | 0.91<br>0.92 | 0.915 | 0.005 | 0.42<br>0.58<br>0.63<br>0.76 | 0.500<br>0.695 | 0.080<br>0.065 | 0.598 | 0.098 | 0.85<br>0.80 | 0.825 | 0.025 | 0.44<br>0.81<br>0.46<br>1.20 | 0.625<br>0.830 | 0.185<br>0.370 | 0.728 | 0.102 |
| 6424 | 1.13<br>1.11 | 1.120 | 0.010 | 0.55<br>0.56<br>0.56<br>0.55 | 0.555<br>0.555 | 0.005<br>0.005 | 0.555 | 0.000 | 1.17<br>1.19 | 1.180 | 0.010 | 0.60<br>0.60<br>0.58<br>0.59 | 0.600<br>0.585 | 0.000<br>0.005 | 0.592 | 0.008 |
| 6552 | 0.75<br>0.75 | 0.750 | 0.000 | 0.30<br>0.34<br>----<br>---- | 0.320<br>----- | 0.020<br>----- | 0.320 | ----- | 1.25<br>1.07 | 1.160 | 0.090 | 0.24<br>0.30<br>----<br>---- | 0.270<br>----- | 0.030<br>----- | 0.270 | ----- |
| 7862 | 2.80<br>2.80 | 2.800 | 0.000 | 1.31<br>1.21<br>----<br>---- | 1.260<br>----- | 0.050<br>----- | 1.260 | ----- | 1.14<br>1.20 | 1.170 | 0.030 | 0.74<br>0.68<br>0.76<br>0.80 | 0.710<br>0.780 | 0.030<br>0.020 | 0.745 | 0.035 |
| 8423 | 0.95<br>---- | 0.95 | ----- | 0.47<br>0.47<br>0.43<br>0.43 | 0.470<br>0.430 | 0.000<br>0.000 | 0.450 | 0.020 | 1.04<br>---- | 1.04 | ----- | 0.50<br>0.50<br>0.53<br>0.53 | 0.500<br>0.530 | 0.000<br>0.000 | 0.515 | 0.015 |
| 9713 | 1.30<br>1.26 | 1.280 | 0.020 | 0.55<br>0.60<br>----<br>---- | 0.575<br>----- | 0.025<br>----- | 0.575 | ----- | 1.21<br>1.26 | 1.235 | 0.025 | 0.59<br>0.53<br>----<br>---- | 0.560<br>----- | 0.030<br>----- | 0.560 | ----- |

Table A-4. TABULATION OF RESULTS FOR DDE

| Lab. No. | Pesticide solution A 0.755 µg/ml | | | Water sample A 0.378 µg/l | | | | | Pesticide solution B 1.510 µg/ml | | | Water sample B 0.755 µg/l | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Results | Assay mean | Assay average deviation | Results | Assay mean | Assay average deviation | Extract mean | Extract average deviation | Results | Assay mean | Assay average deviation | Results | Assay mean | Assay average deviation | Extract mean | Extract average deviation |
| 020 | 2.40<br>2.40 | 2.400 | 0.000 | 1.18<br>1.17<br>1.00<br>0.98 | 1.175<br>0.990 | 0.005<br>0.010 | 1.082 | 0.092 | 2.00<br>2.00 | 2.000 | 0.000 | 0.99<br>0.98<br>1.00<br>0.97 | 0.985<br>0.985 | 0.005<br>0.015 | 0.985 | 0.000 |
| 021 | 0.30<br>0.33 | 0.315 | 0.015 | 0.220<br>0.236<br>0.188<br>0.164 | 0.228<br>0.176 | 0.008<br>0.012 | 0.202 | 0.026 | 0.71<br>0.72 | 0.715 | 0.005 | 0.380<br>0.348<br>0.480<br>0.502 | 0.364<br>0.491 | 0.016<br>0.011 | 0.428 | 0.064 |
| 023 | 0.80<br>0.78 | 0.790 | 0.010 | 0.38<br>0.39<br>0.38<br>0.38 | 0.385<br>0.380 | 0.005<br>0.000 | 0.382 | 0.002 | 1.50<br>1.50 | 1.50 | 0.000 | 0.73<br>0.73<br>0.72<br>0.70 | 0.730<br>0.710 | 0.000<br>0.010 | 0.720 | 0.010 |
| 027B | 1.10<br>1.00 | 1.050 | 0.050 | 0.40<br>0.50<br>0.40<br>0.40 | 0.450<br>0.400 | 0.050<br>0.000 | 0.425 | 0.025 | 1.20<br>1.30 | 1.250 | 0.050 | 0.50<br>0.40<br>0.40<br>0.50 | 0.450<br>0.450 | 0.050<br>0.050 | 0.450 | 0.000 |
| 027C | 0.75<br>0.75 | 0.750 | 0.000 | 0.37<br>0.37<br>0.36<br>0.35 | 0.370<br>0.355 | 0.000<br>0.005 | 0.362 | 0.008 | 1.60<br>1.60 | 1.600 | 0.000 | 0.77<br>0.77<br>0.78<br>0.76 | 0.770<br>0.770 | 0.000<br>0.010 | 0.770 | 0.000 |
| 030 | 0.70<br>---- | 0.70 | ----- | 0.24<br>----<br>0.34<br>---- | 0.24<br>0.34 | -----<br>----- | 0.290 | 0.050 | 1.52<br>1.80 | 1.660 | 0.140 | 0.67<br>----<br>0.75<br>---- | 0.670<br>0.750 | -----<br>----- | 0.710 | 0.040 |
| 035 | 0.65<br>0.62 | 0.635 | 0.015 | 0.20<br>0.20<br>0.20<br>0.18 | 0.200<br>0.190 | 0.000<br>0.010 | 0.195 | 0.005 | 0.98<br>0.99 | 0.985 | 0.005 | 0.35<br>0.35<br>0.30<br>0.43 | 0.350<br>0.365 | 0.000<br>0.065 | 0.358 | 0.008 |
| 046 | 0.63<br>0.70 | 0.665 | 0.035 | 0.37<br>0.39<br>0.35<br>0.34 | 0.380<br>0.345 | 0.010<br>0.005 | 0.362 | 0.018 | 1.20<br>1.42 | 1.310 | 0.110 | 0.64<br>0.67<br>0.69<br>0.69 | 0.655<br>0.690 | 0.015<br>0.000 | 0.672 | 0.018 |

(Table A-4 continued)

| Lab. No. | Pesticide solution A 0.755 µg/ml | | | Water sample A 0.378 µg/l | | | | | Pesticide solution B 1.510 µg/ml | | | Water sample B 0.756 µg/l | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Results | Assay mean | Assay average deviation | Results | Assay mean | Assay average deviation | Extract mean | Extract average deviation | Results | Assay mean | Assay average deviation | Results | Assay mean | Assay average deviation | Extract mean | Extract average deviation |
| 048 | 0.50<br>0.42 | 0.460 | 0.040 | 0.23<br>0.24<br>0.27<br>0.28 | 0.235<br>0.275 | 0.005<br>0.005 | 0.255 | 0.020 | 1.32<br>1.25 | 1.285 | 0.035 | 0.90<br>0.99<br>0.92<br>0.87 | 0.945<br>0.895 | 0.045<br>0.025 | 0.920 | 0.025 |
| 049 | 0.70<br>0.67 | 0.685 | 0.015 | 0.34<br>0.36<br>0.34<br>0.34 | 0.350<br>0.340 | 0.010<br>0.000 | 0.345 | 0.005 | 1.50<br>1.46 | 1.480 | 0.020 | 0.60<br>0.60<br>0.65<br>0.70 | 0.600<br>0.675 | 0.000<br>0.025 | 0.638 | 0.038 |
| 050 | 1.00<br>0.96 | 0.980 | 0.020 | 0.29<br>0.34<br>0.31<br>0.28 | 0.315<br>0.295 | 0.025<br>0.015 | 0.305 | 0.010 | 1.58<br>1.42 | 1.500 | 0.080 | 0.61<br>0.65<br>0.80<br>0.57 | 0.630<br>0.685 | 0.020<br>0.115 | 0.658 | 0.028 |
| 1315 | 0.72<br>0.73 | 0.725 | 0.005 | 0.37<br>0.39<br>0.43<br>0.40 | 0.380<br>0.415 | 0.010<br>0.015 | 0.398 | 0.018 | 1.72<br>1.72 | 1.720 | 0.000 | 0.76<br>0.68<br>0.80<br>0.91 | 0.720<br>0.855 | 0.040<br>0.055 | 0.788 | 0.068 |
| 1365 | 0.79<br>0.75 | 0.770 | 0.020 | 0.30<br>0.36<br>0.38<br>0.42 | 0.330<br>0.400 | 0.030<br>0.020 | 0.365 | 0.035 | 1.77<br>1.78 | 1.775 | 0.005 | 0.62<br>0.56<br>0.71<br>0.66 | 0.590<br>0.685 | 0.030<br>0.025 | 0.638 | 0.048 |
| 1911 | 1.00<br>1.00 | 1.000 | 0.000 | 0.39<br>0.60<br>0.37<br>0.44 | 0.495<br>0.405 | 0.105<br>0.035 | 0.450 | 0.045 | 1.00<br>1.00 | 1.000 | 0.000 | 0.56<br>0.60<br>0.55<br>0.65 | 0.580<br>0.600 | 0.020<br>0.050 | 0.590 | 0.010 |
| 2311 | 1.14<br>1.10 | 1.120 | 0.020 | 0.55<br>0.56<br>0.574<br>0.574 | 0.555<br>0.574 | 0.005<br>0.000 | 0.564 | 0.010 | 1.62<br>1.63 | 1.625 | 0.005 | 0.850<br>0.850<br>0.790<br>0.785 | 0.850<br>0.738 | 0.000<br>0.002 | 0.819 | 0.031 |
| 2841 | 1.45<br>1.38 | 1.415 | 0.035 | 0.87<br>0.88<br>----<br>---- | 0.875<br>----- | 0.005<br>----- | 0.875 | ----- | 2.40<br>2.37 | 2.385 | 0.015 | 1.40<br>1.30<br>1.22<br>1.21 | 1.350<br>1.215 | 0.050<br>0.005 | 1.282 | 0.068 |

(Table A-4 continued)

| Lab. No. | Pesticide solution A 0.755 µg/ml | | | Water sample A 0.378 µg/l | | | | | Pesticide solution B 1.510 µg/ml | | | Water sample B 0.755 µg/l | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Results | Assay mean | Assay average deviation | Results | Assay mean | Assay average deviation | Extract mean | Extract average deviation | Results | Assay mean | Assay average deviation | Results | Assay mean | Assay average deviation | Extract mean | Extract average deviation |
| 3111 | ----<br>---- | ----- | ----- | 0.51<br>0.61<br>0.62<br>0.64 | 0.560<br>0.630 | 0.050<br>0.010 | 0.595 | 0.035 | ----<br>---- | ----- | ----- | 0.66<br>0.61<br>0.58<br>0.61 | 0.635<br>0.595 | 0.025<br>0.015 | 0.615 | 0.020 |
| 4511 | 3.10<br>2.73 | 2.915 | 0.185 | 0.85<br>----<br>0.70<br>---- | 0.85<br>0.70 | -----<br>----- | 0.775 | 0.075 | 2.00<br>1.83 | 1.915 | 0.085 | 0.86<br>----<br>0.36<br>0.36 | 0.86<br>0.360 | -----<br>0.000 | 0.610 | 0.250 |
| 4523 | 0.89<br>0.87 | 0.880 | 0.010 | 0.22<br>0.22<br>0.19<br>0.23 | 0.220<br>0.210 | 0.000<br>0.020 | 0.215 | 0.005 | 1.98<br>1.88 | 1.930 | 0.050 | 0.32<br>0.37<br>0.45<br>0.39 | 0.345<br>0.420 | 0.025<br>0.030 | 0.382 | 0.038 |
| 4711 | 0.10<br>0.10 | 0.100 | 0.000 | ----<br>----<br>----<br>---- | -----<br>----- | -----<br>----- | ----- | ----- | 0.20<br>0.20 | 0.200 | 0.000 | 0.10<br>0.10<br>0.10<br>0.10 | 0.100<br>0.100 | 0.000<br>0.000 | 0.100 | 0.000 |
| 5511 | 1.52<br>1.47 | 1.495 | 0.025 | 0.43<br>----<br>0.43<br>---- | 0.43<br>0.43 | -----<br>----- | 0.430 | 0.000 | 1.63<br>1.60 | 1.615 | 0.015 | 0.70<br>----<br>0.76<br>---- | 0.70<br>0.76 | -----<br>----- | 0.730 | 0.030 |
| 5811 | 0.54<br>0.82 | 0.680 | 0.140 | 0.72<br>0.77<br>0.51<br>0.58 | 0.745<br>0.545 | 0.025<br>0.035 | 0.645 | 0.100 | 1.12<br>0.93 | 1.025 | 0.095 | 0.67<br>0.98<br>0.77<br>1.35 | 0.825<br>1.060 | 0.155<br>0.290 | 0.943 | 0.118 |
| 6424 | 0.91<br>0.89 | 0.900 | 0.010 | 0.45<br>0.47<br>0.47<br>0.47 | 0.460<br>0.470 | 0.010<br>0.000 | 0.465 | 0.005 | 1.78<br>1.86 | 1.820 | 0.040 | 0.89<br>0.93<br>0.89<br>0.91 | 0.910<br>0.900 | 0.020<br>0.010 | 0.905 | 0.005 |
| 6552 | 0.78<br>0.53 | 0.655 | 0.125 | 0.45<br>0.43<br>----<br>---- | 0.440<br>----- | 0.010<br>----- | 0.440 | ----- | 1.44<br>1.11 | 1.275 | 0.165 | 0.42<br>0.48<br>----<br>---- | 0.450<br>----- | 0.030<br>----- | 0.450 | ----- |

(Table A-4 continued)

| Lab. No. | Pesticide solution A 0.755 µg/ml | | | Water sample A 0.378 µg/l | | | | | Pesticide solution B 1.510 µg/ml | | | Water sample B 0.755 µg/l | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Results | Assay mean | Assay average deviation | Results | Assay mean | Assay average deviation | Extract mean | Extract average deviation | Results | Assay mean | Assay average deviation | Results | Assay mean | Assay average deviation | Extract mean | Extract average deviation |
| 7662 | 1.40<br>1.75 | 1.575 | 0.175 | 0.71<br>0.80<br>----<br>---- | 0.755 | 0.045<br>-----<br>----- | 0.755 | ----- | 1.88<br>2.04 | 1.960 | 0.080 | 1.55<br>1.59<br>1.59<br>1.50 | 1.570<br>1.545 | 0.020<br>0.045 | 1.558 | 0.012 |
| 9713 | 1.65<br>1.55 | 1.600 | 0.050 | 0.76<br>0.69<br>----<br>---- | 0.725 | 0.035<br>-----<br>----- | 0.725 | ----- | 1.86<br>1.90 | 1.880 | 0.020 | 0.83<br>0.80<br>----<br>---- | 0.815<br>----- | 0.015<br>----- | 0.815 | ----- |

Table A-5. TABULATION OF RESULTS FOR DIELDRIN

| Lab. No. | Pesticide solution A 1.552 µg/ml | | | Water sample A 0.776 µg/l | | | | | Pesticide solution B 0.720 µg/ml | | | Water sample B 0.360 µg/l | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Results | Assay mean | Assay average deviation | Results | Assay mean | Assay average deviation | Extract mean | Extract average deviation | Results | Assay mean | Assay average deviation | Results | Assay mean | Assay average deviation | Extract mean | Extract average deviation |
| 020 | 0.00<br>0.00 | 0.00 | 0.000 | 0.00<br>0.00<br>0.00<br>0.00 | 0.00<br>0.00 | 0.00<br>0.000 | 0.00 | 0.00 | 0.00<br>0.00 | 0.00 | 0.000 | 0.00<br>0.00<br>0.00<br>0.00 | 0.00<br>0.00 | 0.000<br>0.000 | 0.000 | 0.000 |
| 023 | 1.50<br>1.50 | 1.50 | 0.000 | 0.75<br>0.75<br>0.74<br>0.76 | 0.750<br>0.750 | 0.000<br>0.010 | 0.750 | 0.000 | 0.74<br>0.75 | 0.745 | 0.005 | 0.36<br>0.38<br>0.37<br>0.37 | 0.370<br>0.370 | 0.010<br>0.000 | 0.370 | 0.000 |
| 027B | 1.20<br>1.10 | 1.150 | 0.050 | 0.4<br>0.4<br>0.4<br>0.3 | 0.40<br>0.35 | 0.000<br>0.050 | 0.375 | 0.025 | 0.9<br>0.9 | 0.90 | 0.000 | 0.3<br>0.2<br>0.2<br>0.2 | 0.25<br>0.20 | 0.050<br>0.000 | 0.225 | 0.025 |
| 027C | 1.53<br>1.53 | 1.53 | 0.000 | 0.76<br>0.76<br>0.74<br>0.72 | 0.760<br>0.730 | 0.000<br>0.010 | 0.745 | 0.015 | 0.55<br>0.58 | 0.565 | 0.015 | 0.29<br>0.29<br>0.29<br>0.28 | 0.290<br>0.285 | 0.000<br>0.005 | 0.288 | 0.002 |
| 030 | 1.78<br>---- | 1.78 | ----- | 0.84<br>----<br>0.94<br>---- | 0.84<br>0.94 | -----<br>----- | 0.890 | 0.050 | 0.70<br>0.76 | 0.730 | 0.030 | 0.36<br>----<br>0.38<br>---- | 0.36<br>0.38 | -----<br>----- | 0.370 | 0.010 |
| 035 | 0.74<br>0.80 | 0.770 | 0.030 | 0.20<br>0.63<br>0.20<br>0.48 | 0.415<br>0.340 | 0.215<br>0.140 | 0.378 | 0.038 | 0.28<br>0.28 | 0.280 | 0.000 | 0.20<br>0.37<br>0.20<br>0.22 | 0.285<br>0.210 | 0.085<br>0.010 | 0.248 | 0.038 |
| 046 | 1.20<br>1.44 | 1.320 | 0.120 | 0.69<br>0.68<br>0.68<br>0.63 | 0.685<br>0.655 | 0.005<br>0.025 | 0.670 | 0.015 | 0.60<br>0.84 | 0.720 | 0.120 | 0.35<br>0.35<br>0.35<br>0.36 | 0.35<br>0.355 | 0.000<br>0.005 | 0.352 | 0.002 |
| 048 | 1.25<br>1.04 | 1.145 | 0.105 | 0.31<br>0.31<br>0.18<br>0.24 | 0.310<br>0.210 | 0.000<br>0.030 | 0.260 | 0.050 | 0.47<br>0.45 | 0.460 | 0.010 | 0.41<br>0.38<br>0.37<br>0.36 | 0.395<br>0.365 | 0.015<br>0.005 | 0.380 | 0.015 |

(Table A-5 continued)

| Lab. No. | Pesticide solution A 1.552 µg/ml | | | Water sample A 0.776 µg/l | | | | | Pesticide solution B 0.720 µg/ml | | | Water sample B 0.360 µg/l | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Results | Assay mean | Assay average deviation | Results | Assay mean | Assay average deviation | Extract mean | Extract average deviation | Results | Assay mean | Assay average deviation | Results | Assay mean | Assay average deviation | Extract mean | Extract average deviation |
| 648 | 1.50 | 1.480 | 0.020 | 0.75 | 0.750 | 0.000 | | | 0.64 | 0.625 | 0.015 | 0.35 | 0.350 | 0.000 | | |
| | 1.46 | | | 0.75 | | | 0.740 | 0.010 | 0.61 | | | 0.35 | | | 0.332 | 0.018 |
| | | | | 0.73 | 0.730 | 0.000 | | | | | | 0.30 | 0.315 | 0.015 | | |
| | | | | 0.73 | | | | | | | | 0.33 | | | | |
| 650 | 1.69 | 1.505 | 0.185 | 0.69 | 0.715 | 0.025 | | | 0.98 | 0.900 | 0.080 | 0.33 | 0.315 | 0.015 | | |
| | 1.32 | | | 0.74 | | | 0.775 | 0.060 | 0.82 | | | 0.30 | | | 0.338 | 0.022 |
| | | | | 0.87 | 0.835 | 0.035 | | | | | | 0.38 | 0.360 | 0.020 | | |
| | | | | 0.80 | | | | | | | | 0.34 | | | | |
| 1315 | 1.52 | 1.635 | 0.115 | 0.98 | 0.935 | 0.045 | | | 0.67 | 0.695 | 0.025 | 0.37 | 0.385 | 0.015 | | |
| | 1.75 | | | 0.89 | | | 0.938 | 0.002 | 0.72 | | | 0.40 | | | 0.388 | 0.002 |
| | | | | 0.89 | 0.940 | 0.050 | | | | | | 0.41 | 0.390 | 0.020 | | |
| | | | | 0.99 | | | | | | | | 0.37 | | | | |
| 1365 | 1.65 | 1.655 | 0.005 | 0.71 | 0.735 | 0.025 | | | 0.74 | 0.74 | 0.000 | 0.40 | 0.375 | 0.025 | | |
| | 1.66 | | | 0.76 | | | 0.742 | 0.008 | 0.74 | | | 0.35 | | | 0.392 | 0.018 |
| | | | | 0.72 | 0.750 | 0.030 | | | | | | 0.46 | 0.410 | 0.050 | | |
| | | | | 0.78 | | | | | | | | 0.36 | | | | |
| 1911 | 1.00 | 1.00 | 0.000 | 0.66 | 0.580 | 0.080 | | | 1.00 | 1.00 | 0.000 | 0.40 | 0.450 | 0.050 | | |
| | 1.00 | | | 0.50 | | | 0.595 | 0.015 | 1.00 | | | 0.50 | | | 0.515 | 0.065 |
| | | | | 0.68 | 0.610 | 0.070 | | | | | | 0.58 | 0.580 | 0.000 | | |
| | | | | 0.54 | | | | | | | | 0.58 | | | | |
| 2311 | 2.25 | 2.245 | 0.005 | 1.250 | 1.222 | 0.028 | | | 1.25 | 1.245 | 0.005 | 0.70 | 0.70 | 0.000 | | |
| | 2.24 | | | 1.195 | | | 1.234 | 0.012 | 1.24 | | | 0.70 | | | 0.700 | 0.000 |
| | | | | 1.250 | 1.245 | 0.005 | | | | | | 0.65 | 0.70 | 0.050 | | |
| | | | | 1.240 | | | | | | | | 0.75 | | | | |
| 2811 | 2.13 | 2.090 | 0.040 | 0.80 | 0.80 | 0.000 | | | 1.30 | 1.290 | 0.010 | 0.65 | 0.635 | 0.015 | | |
| | 2.05 | | | 0.80 | | | 0.800 | ----- | 1.28 | | | 0.62 | | | 0.702 | 0.068 |
| | | | | ---- | ---- | ----- | | | | | | 0.78 | 0.770 | 0.010 | | |
| | | | | ---- | | | | | | | | 0.76 | | | | |
| 3111 | ---- | ----- | ----- | 0.03 | 0.030 | 0.000 | | | ---- | ----- | ----- | 0.11 | 0.110 | 0.000 | | |
| | ---- | | | 0.03 | | | 0.030 | 0.000 | ---- | | | 0.11 | | | 0.138 | 0.028 |
| | | | | 0.03 | 0.030 | | | | | | | 0.17 | 0.165 | 0.005 | | |
| | | | | 0.03 | | | | | | | | 0.16 | | | | |

(Table A-5 continued)

| Lab. No. | Pesticide solution A 1.552 µg/ml | | | Water sample A 0.776 µg/l | | | | | Pesticide solution B 0.720 µg/ml | | | Water sample B 0.360 µg/l | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Results | Assay mean | Assay average deviation | Results | Assay mean | Assay average deviation | Extract mean | Extract average deviation | Results | Assay mean | Assay average deviation | Results | Assay mean | Assay average deviation | Extract mean | Extract average deviation |
| 3911 | 2.60<br>2.60 | 2.60 | 0.000 | 1.02<br>1.02<br>1.00<br>0.98 | 1.020<br>0.990 | 0.000<br>0.010 | 1.005 | 0.015 | 2.60<br>2.60 | 2.600 | 0.000 | 0.86<br>0.86<br>0.93<br>0.87 | 0.860<br>0.900 | 0.000<br>0.030 | 0.880 | 0.020 |
| 4511 | 6.17<br>6.07 | 6.120 | 0.050 | 1.02<br>0.99<br>0.98<br>0.92 | 1.005<br>0.950 | 0.015<br>0.030 | 0.978 | 0.028 | 1.13<br>1.71 | 1.420 | 0.290 | 0.33<br>0.38<br>0.69<br>0.67 | 0.355<br>0.680 | 0.025<br>0.010 | 0.518 | 0.162 |
| 4533 | 1.45<br>1.39 | 1.420 | 0.030 | 0.40<br>0.39<br>0.34<br>0.38 | 0.395<br>0.360 | 0.005<br>0.020 | 0.378 | 0.018 | 0.80<br>0.79 | 0.795 | 0.005 | 0.15<br>0.16<br>0.18<br>0.17 | 0.155<br>0.175 | 0.005<br>0.005 | 0.165 | 0.010 |
| 5511 | ----<br>---- | ----- | ----- | 0.40<br>----<br>0.19<br>---- | 0.40<br>0.19 | -----<br>----- | 0.295 | 0.105 | ----<br>---- | ----- | ----- | 0.08<br>----<br>0.23<br>---- | 0.08<br>0.23 | -----<br>----- | 0.155 | 0.075 |
| 5811 | 1.29<br>1.11 | 1.200 | 0.090 | 0.40<br>0.43<br>0.50<br>0.61 | 0.415<br>0.555 | 0.015<br>0.055 | 0.485 | 0.070 | 0.49<br>0.62 | 0.550 | 0.060 | 0.24<br>0.19<br>0.23<br>0.27 | 0.215<br>0.250 | 0.025<br>0.020 | 0.232 | 0.018 |
| 6424 | 1.69<br>1.66 | 1.67[illegible] | 0.015 | 0.82<br>0.84<br>0.84<br>0.84 | 0.830<br>0.840 | 0.010<br>0.000 | 0.835 | 0.005 | 0.75<br>0.78 | 0.765 | 0.015 | 0.38<br>0.38<br>0.36<br>0.38 | 0.38<br>0.370 | 0.000<br>0.010 | 0.375 | 0.005 |
| 6552 | 1.50<br>1.48 | 1.490 | 0.010 | 0.65<br>0.63<br>----<br>---- | 0.640<br>----- | 0.010<br>----- | 0.640 | ----- | 0.94<br>0.80 | 0.870 | 0.070 | 0.28<br>0.32<br>----<br>---- | 0.300<br>----- | 0.020<br>----- | 0.300 | ----- |
| 6715 | 1.48<br>1.56 | 1.520 | 0.040 | ----<br>----<br>----<br>---- | -----<br>----- | -----<br>----- | ----- | ----- | 0.84<br>0.80 | 0.820 | 0.020 | ----<br>----<br>----<br>---- | -----<br>----- | -----<br>----- | ----- | ----- |

(Table A-5 continued)

| Lab. No. | Pesticide solution A 1.552 µg/ml | | | Water sample A 0.776 µg/l | | | | | Pesticide solution B 0.720 µg/ml | | | Water sample B 0.360 µg/l | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Results | Assay mean | Assay average deviation | Results | Assay mean | Assay average deviation | Extract mean | Extract average deviation | Results | Assay mean | Extract average deviation | Results | Assay mean | Assay average deviation | Extract mean | Extract average deviation |
| 7862 | 0.80 | 0.80 | 0.000 | 0.40 | 0.40 | 0.000 | | | 0.32 | 0.360 | 0.040 | 0.10 | 0.120 | 0.020 | | |
| | 0.80 | | | 0.40 | | | 0.400 | ----- | 0.40 | | | 0.14 | | | 0.155 | 0.035 |
| | | | | ---- | ---- | ----- | | | | | | 0.19 | 0.190 | 0.000 | | |
| | | | | ---- | | | | | | | | 0.19 | | | | |
| 8423 | 1.95 | 1.95 | ----- | 1.01 | 1.010 | 0.000 | | | 2.02 | 2.020 | ----- | 1.01 | 1.010 | 0.000 | | |
| | ---- | | | 1.01 | | | 1.005 | 0.005 | ---- | | | 1.01 | | | 0.995 | 0.015 |
| | | | | 1.00 | 1.000 | 0.000 | | | | | | 0.98 | 0.980 | 0.000 | | |
| | | | | 1.00 | | | | | | | | 0.98 | | | | |
| 9743 | 1.85 | 1.925 | 0.075 | 0.89 | 0.900 | 0.010 | | | 0.50 | 0.525 | 0.025 | 0.20 | 0.225 | 0.025 | | |
| | 2.00 | | | 0.91 | | | 0.900 | ----- | 0.55 | | | 0.25 | | | 0.225 | ----- |
| | | | | ---- | ----- | ----- | | | | | | ---- | ----- | ----- | | |
| | | | | ---- | | | | | | | | ---- | | | | |

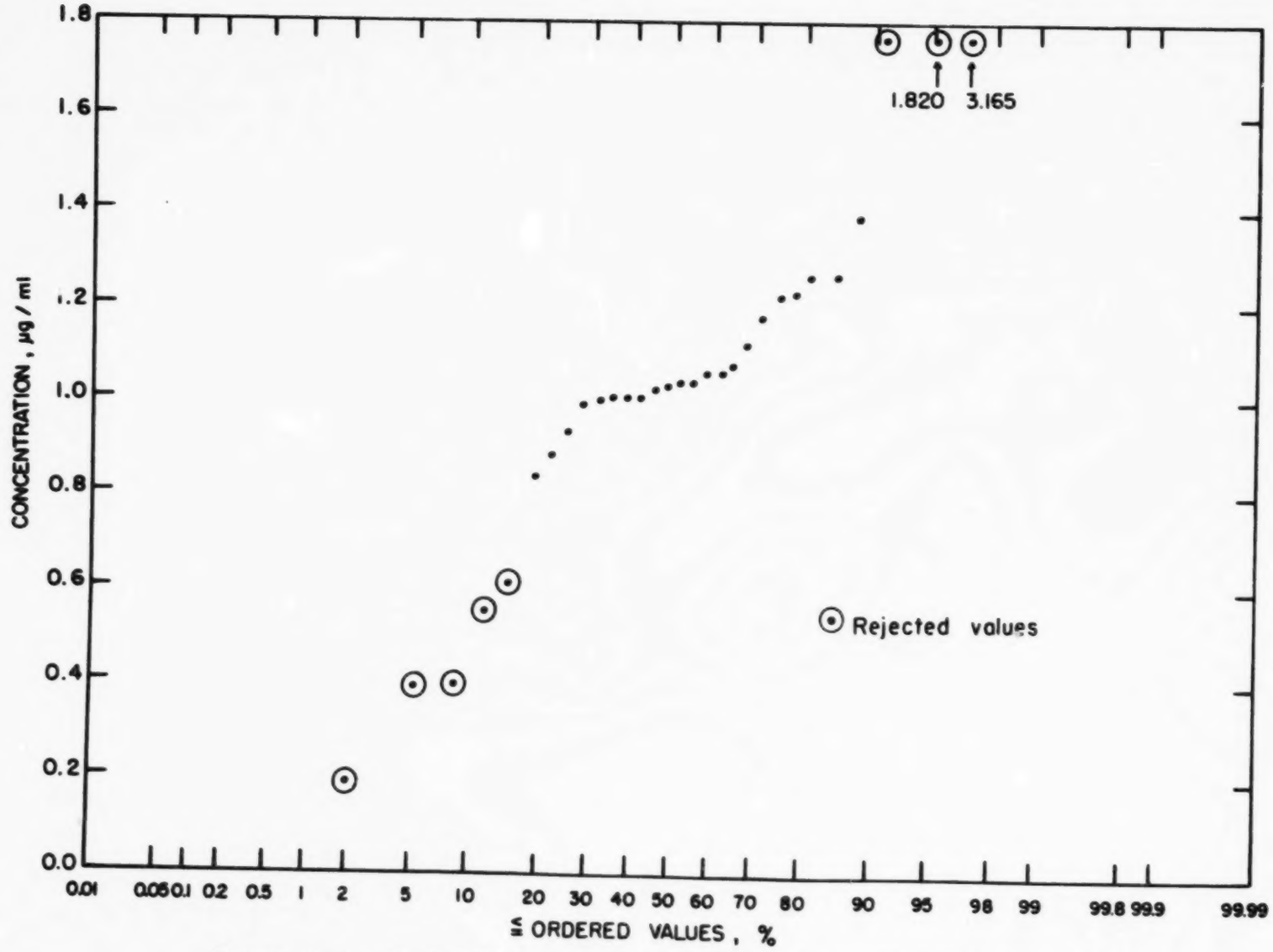


Figure B-1. Probability curve for lindane in pesticide solution A.

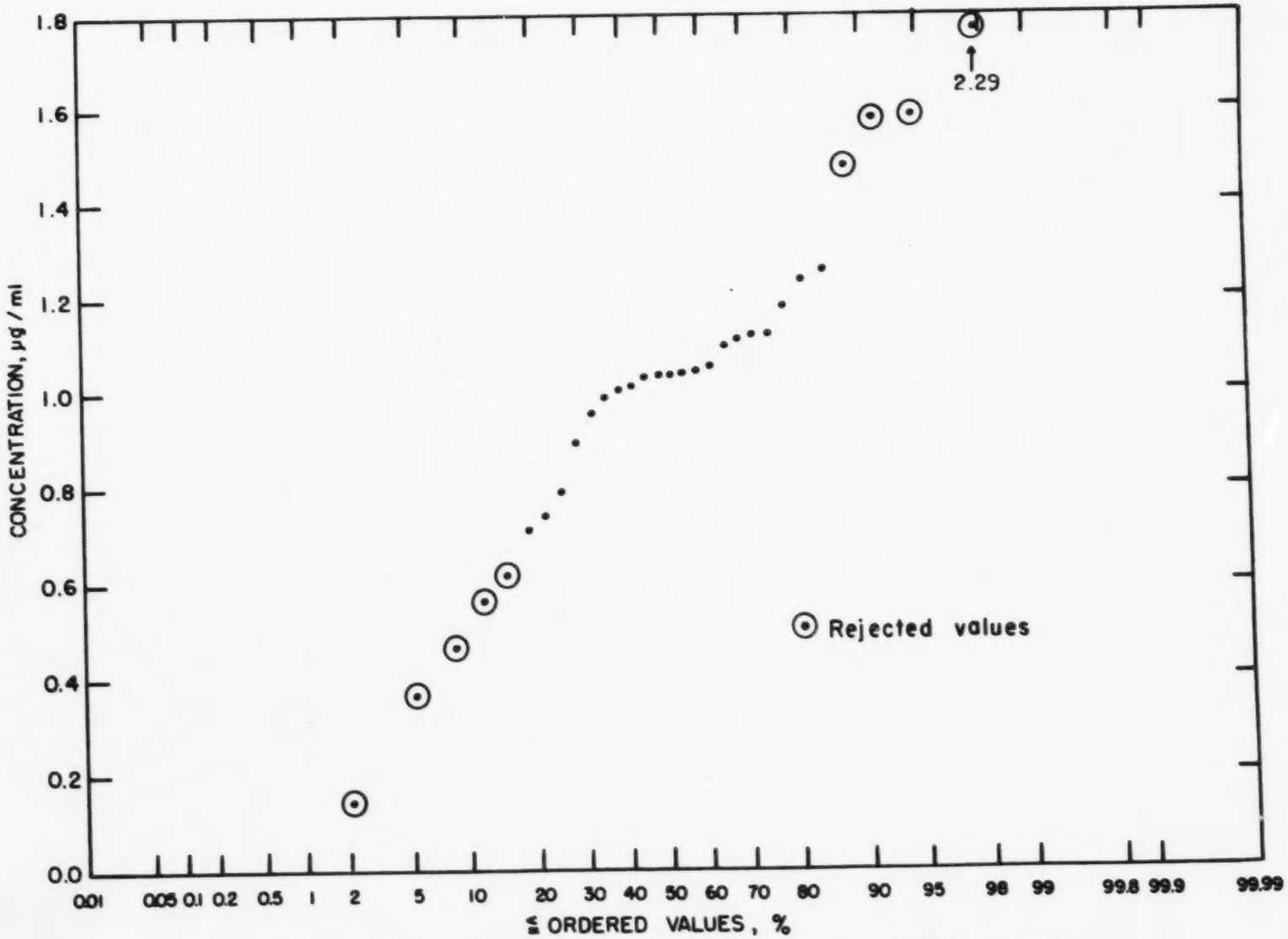


Figure B-2. Probability curve for lindane in pesticide solution B.

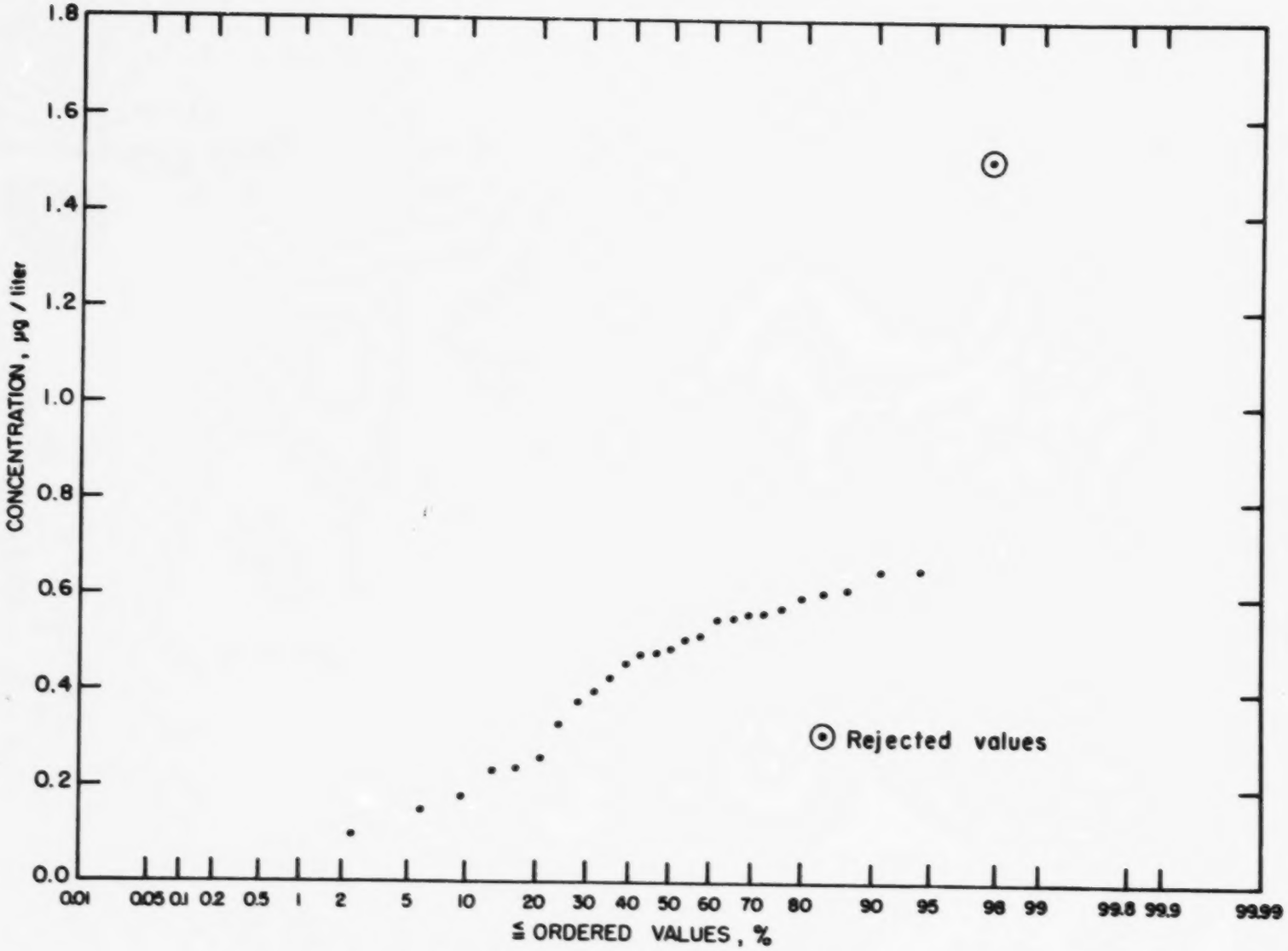


Figure B-3. Probability curve for lindane in water sample A.

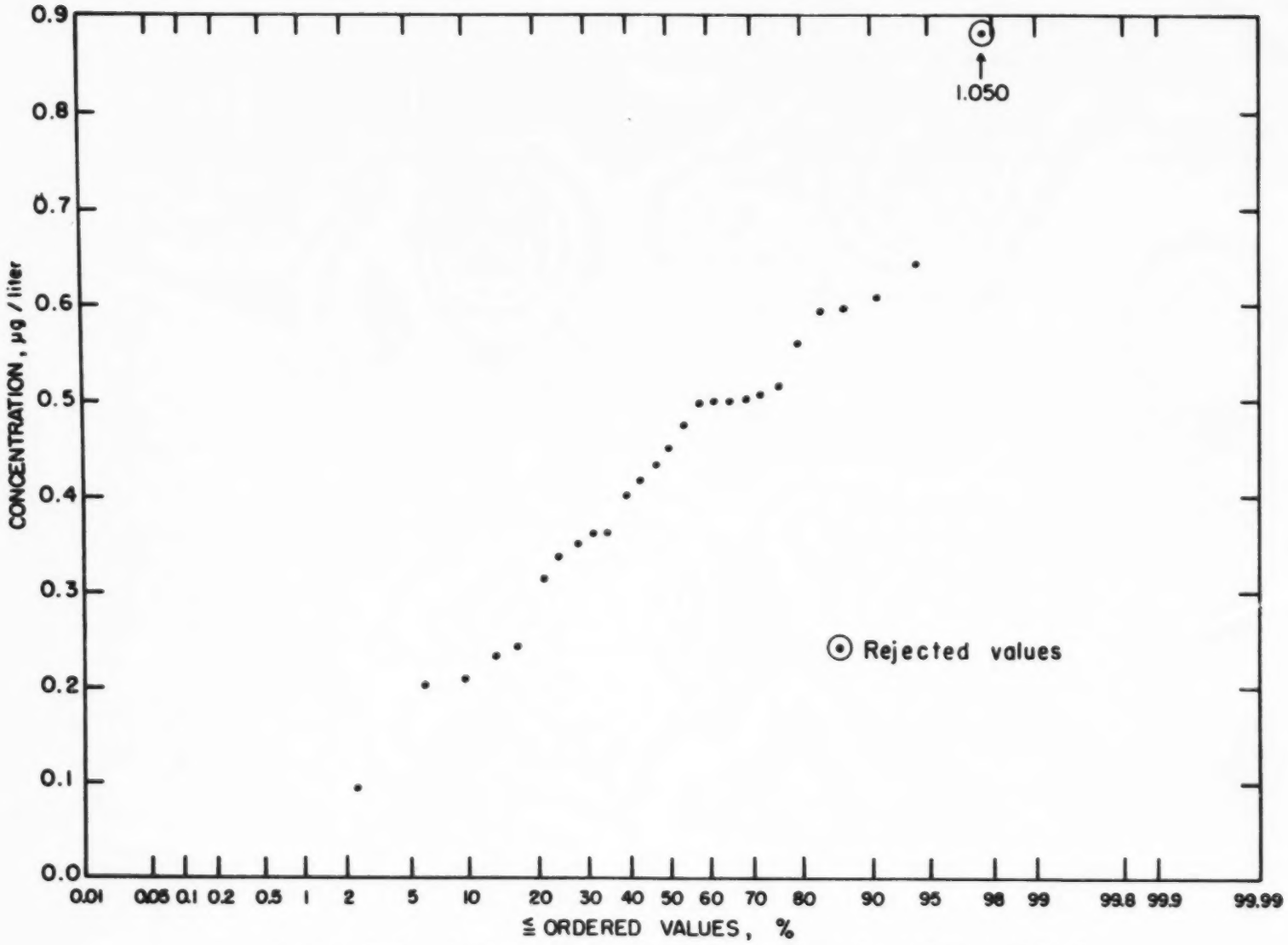


Figure B-4. Probability curve for lindane in water sample B.

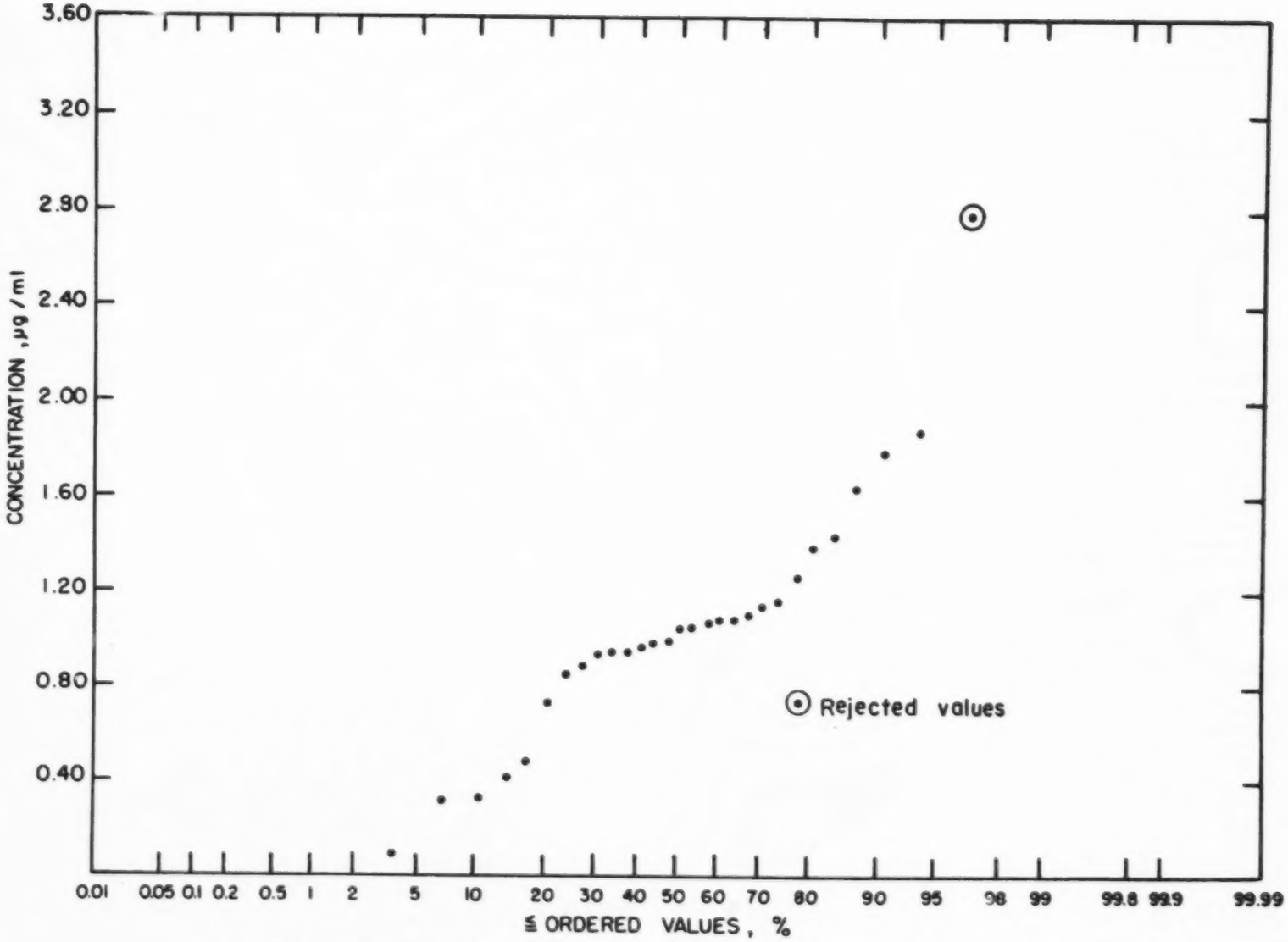


Figure B-5. Probability curve for heptachlor epoxide in pesticide solution A.

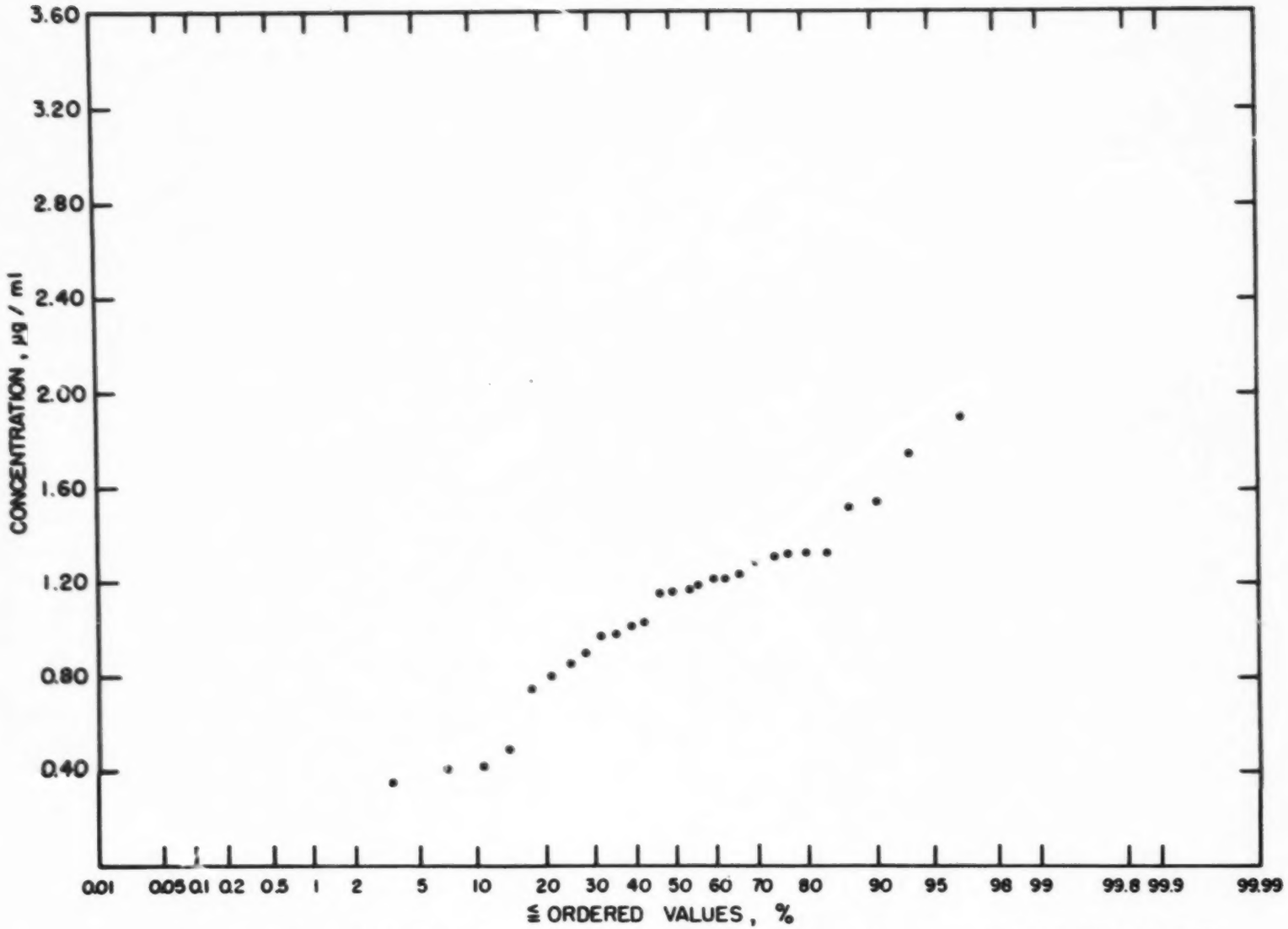


Figure B-6. Probability curve for heptachlor epoxide in pesticide solution B.

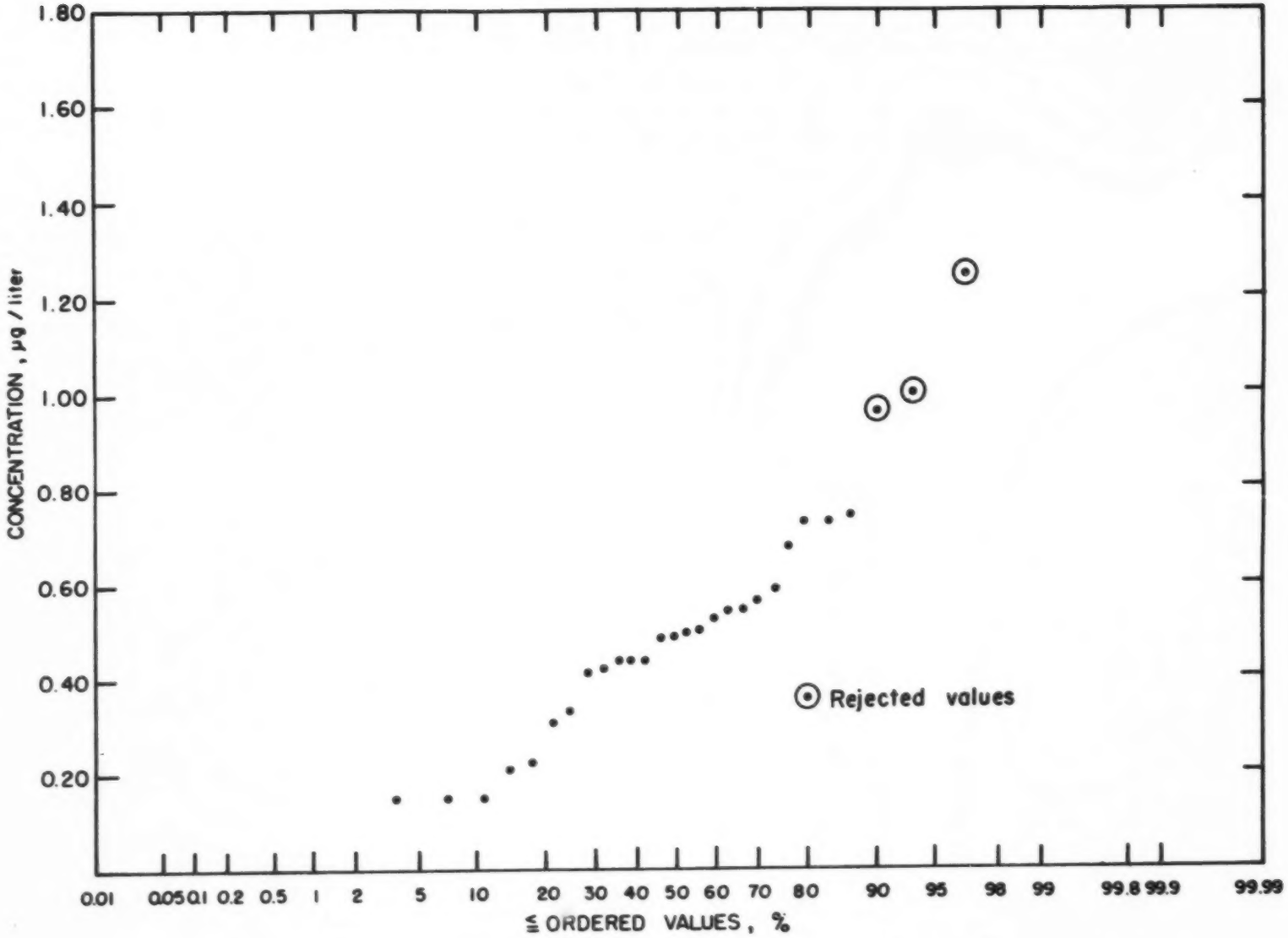


Figure B-7. Probability curve for heptachlor epoxide in water sample A.

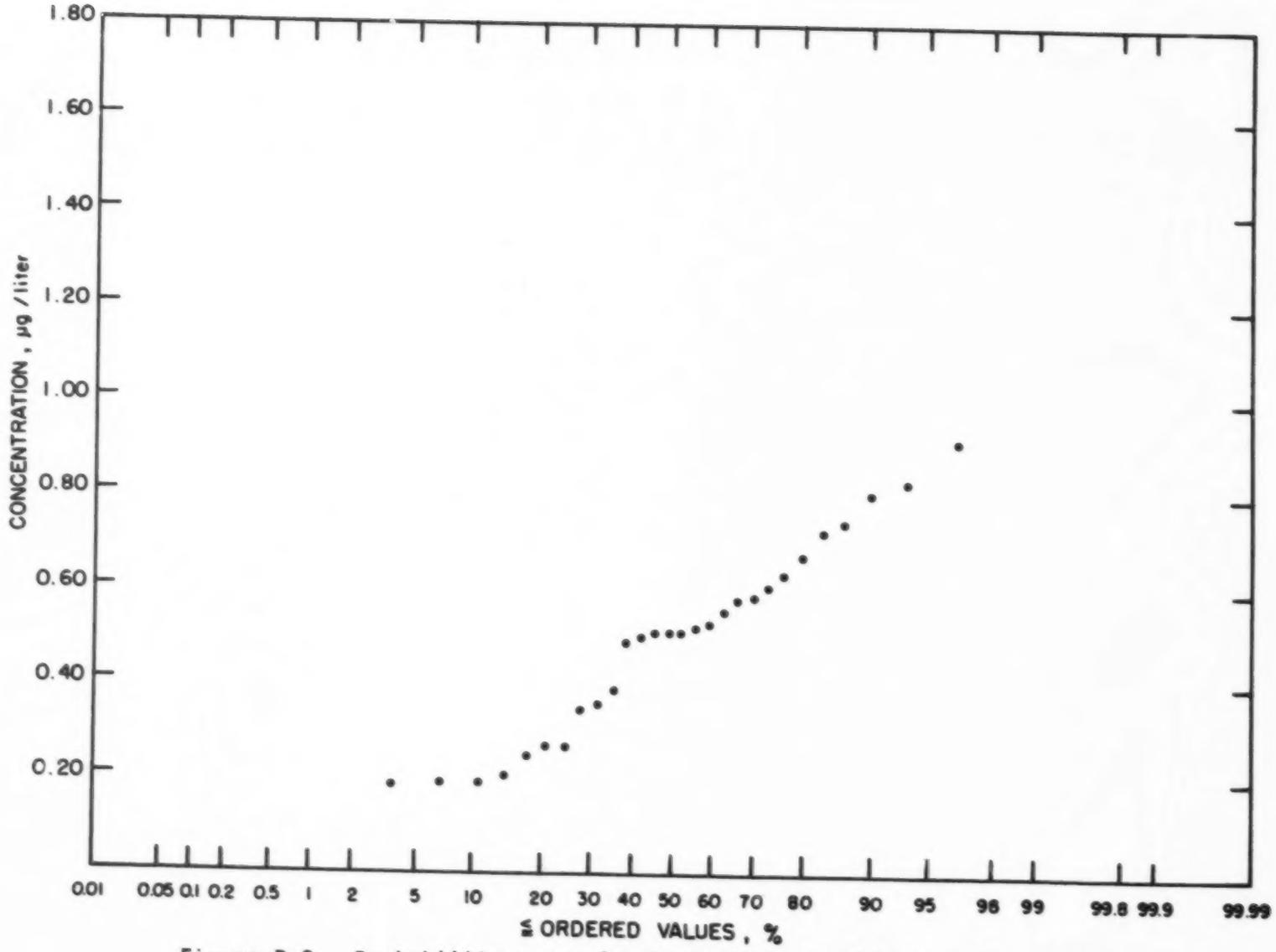


Figure B-8. Probability curve for heptachlor epoxide in water sample B.

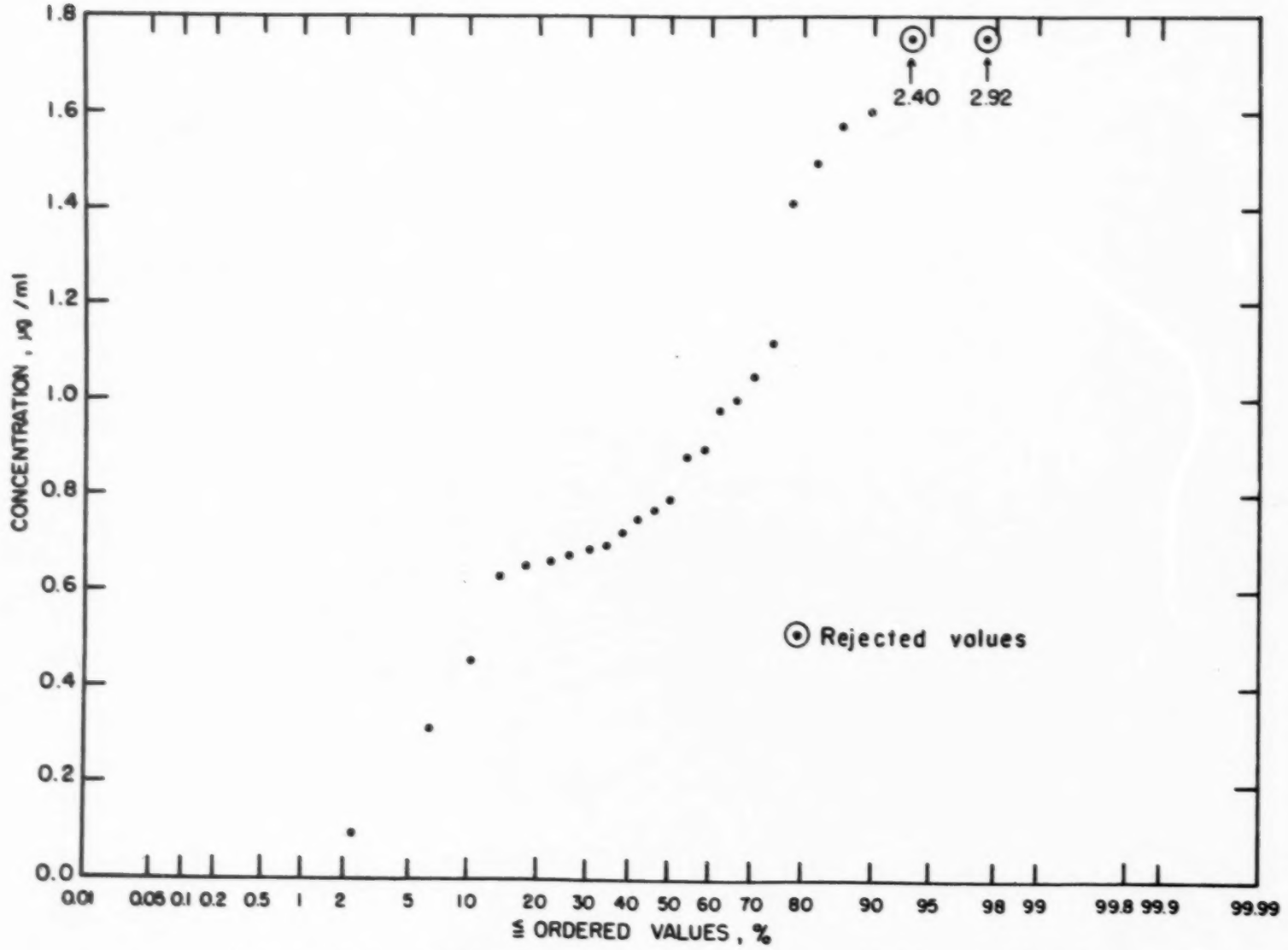


Figure B-9. Probability curve for DDE in pesticide solution A.

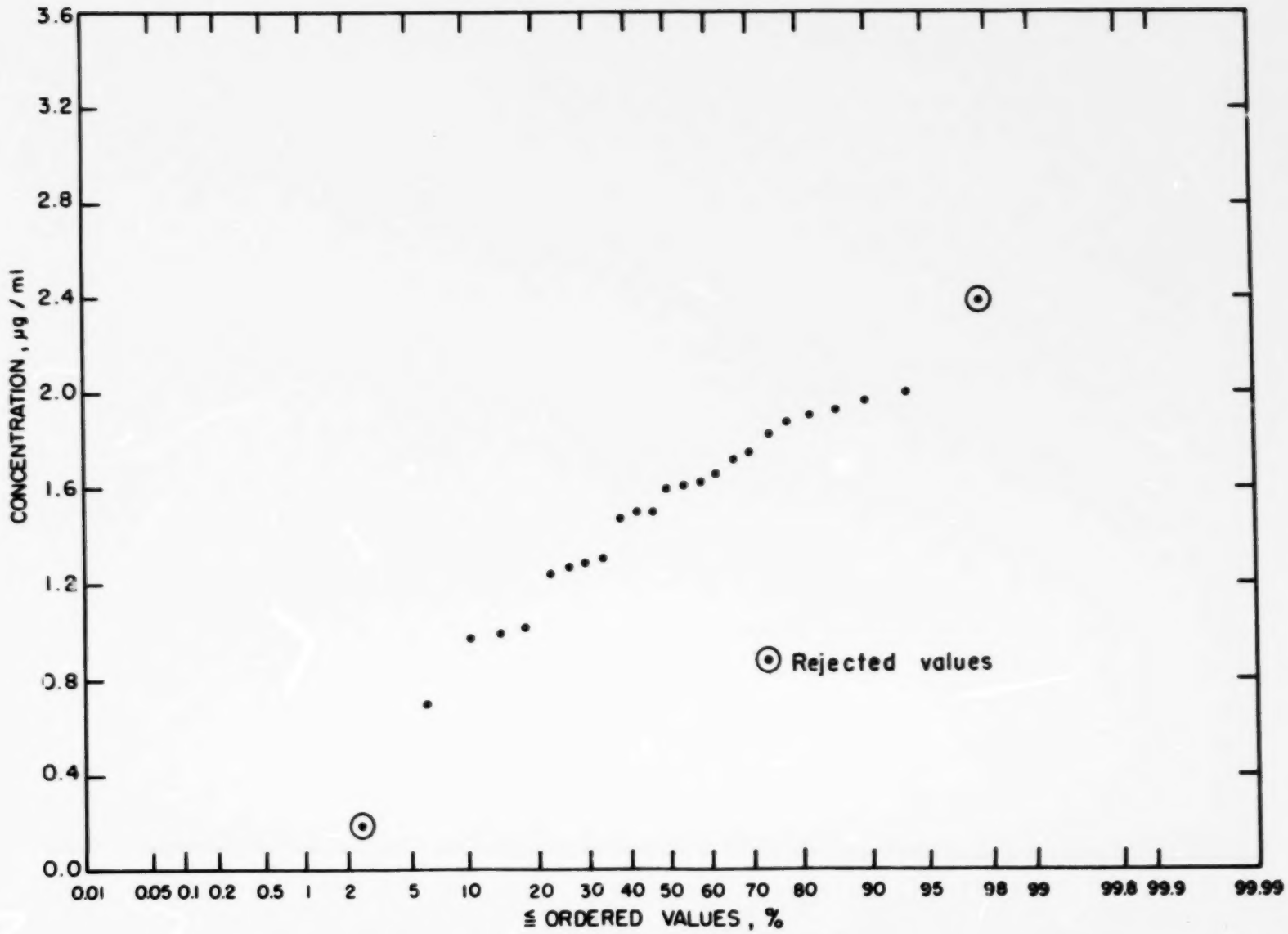


Figure B-10. Probability curve for DDE in pesticide solution B.

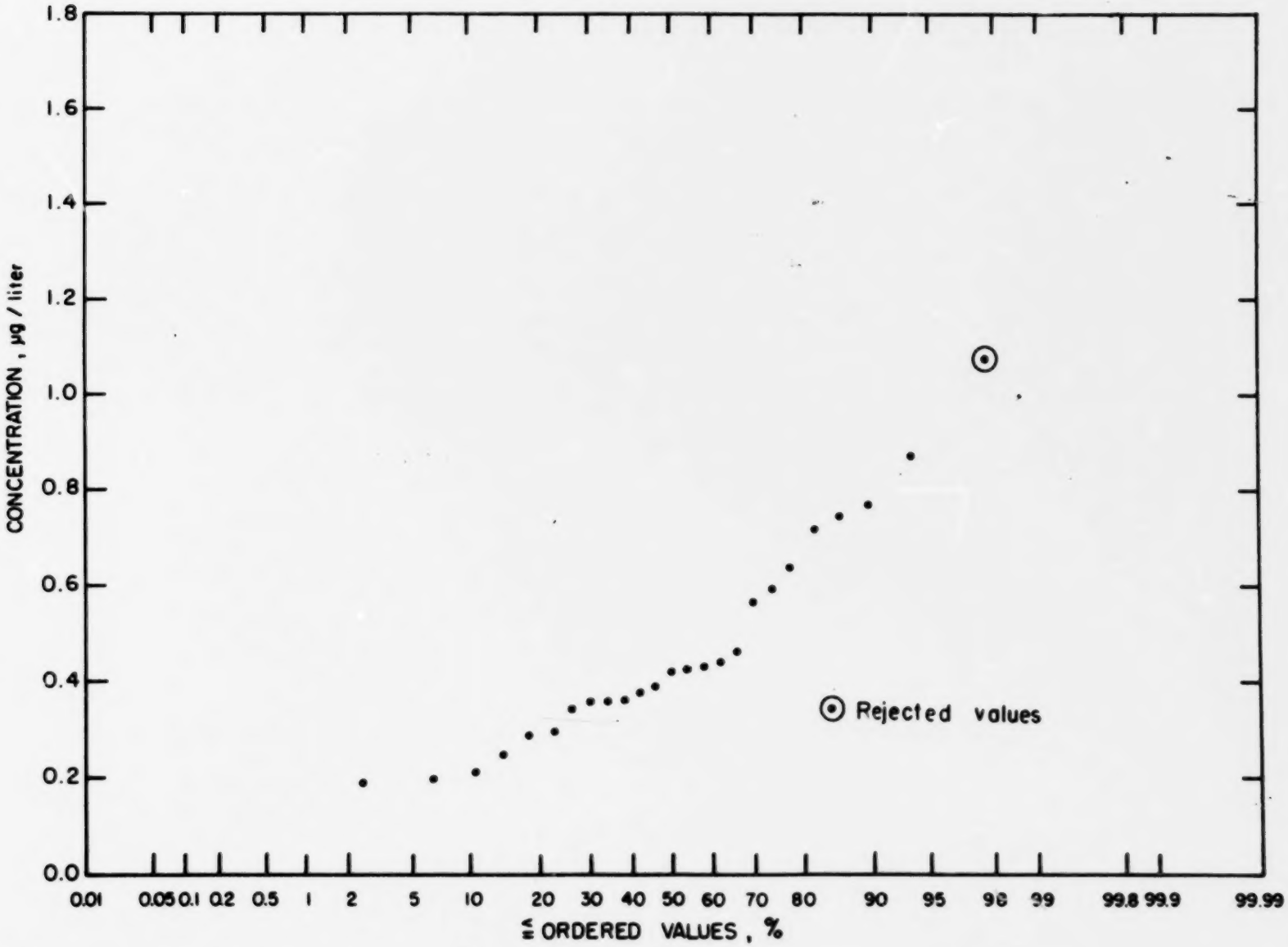


Figure B-11. Probability curve for DDE in water sample A.

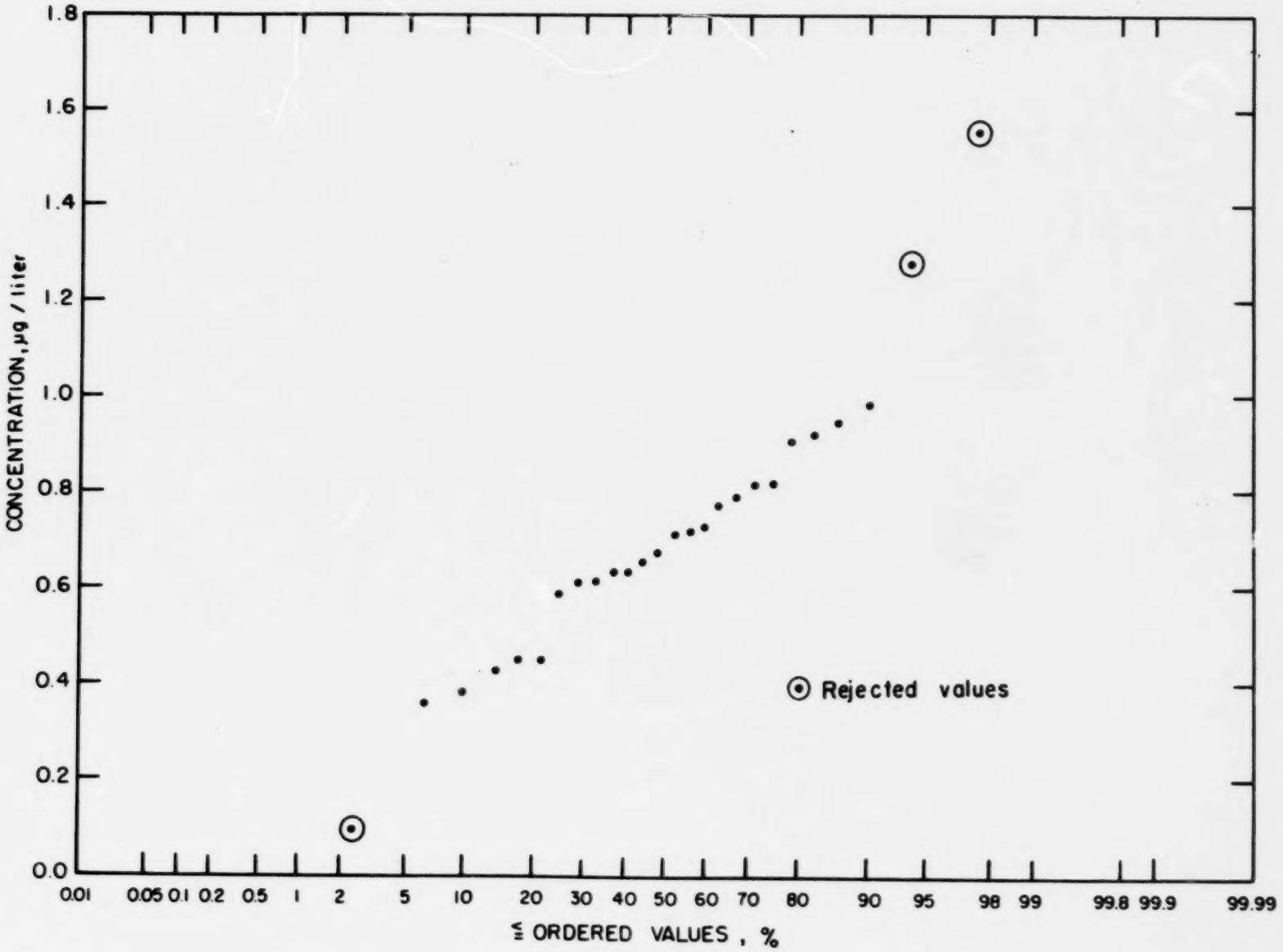


Figure B-12. Probability curve for DDE in water sample B.

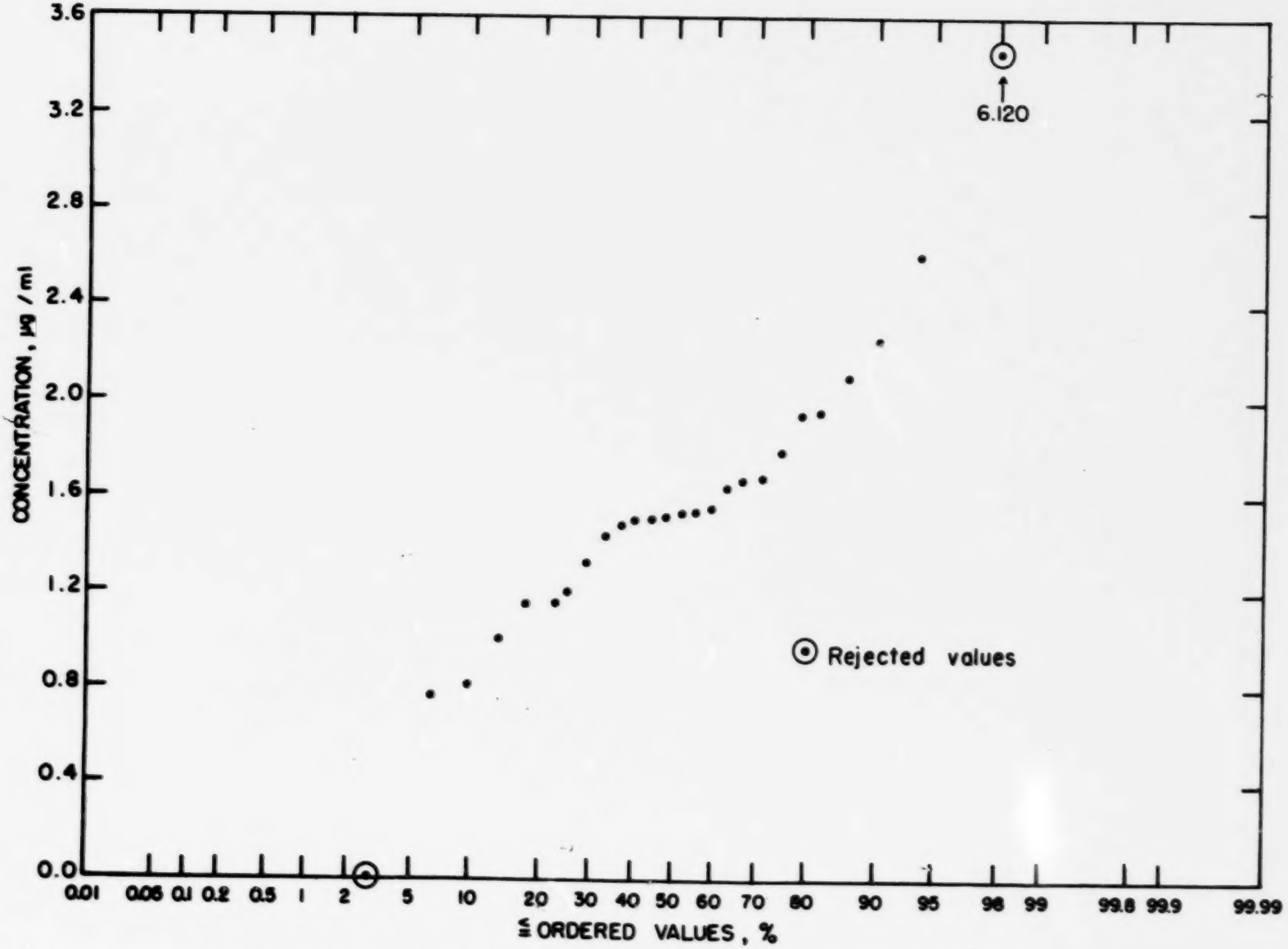


Figure B-13. Probability curve for dieldrin in pesticide solution A.

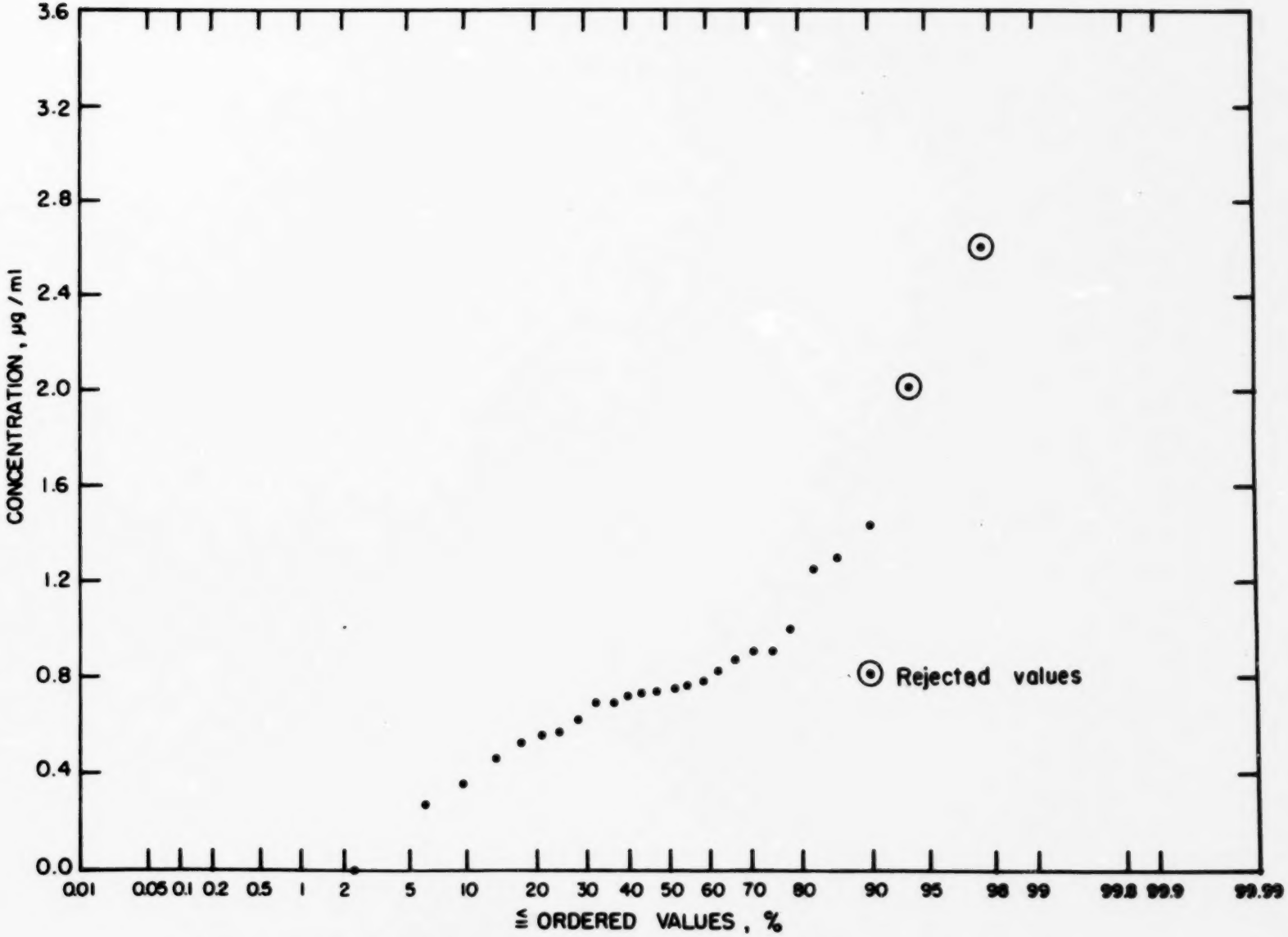


Figure B-14. Probability curve for dieldrin in pesticide solution B.

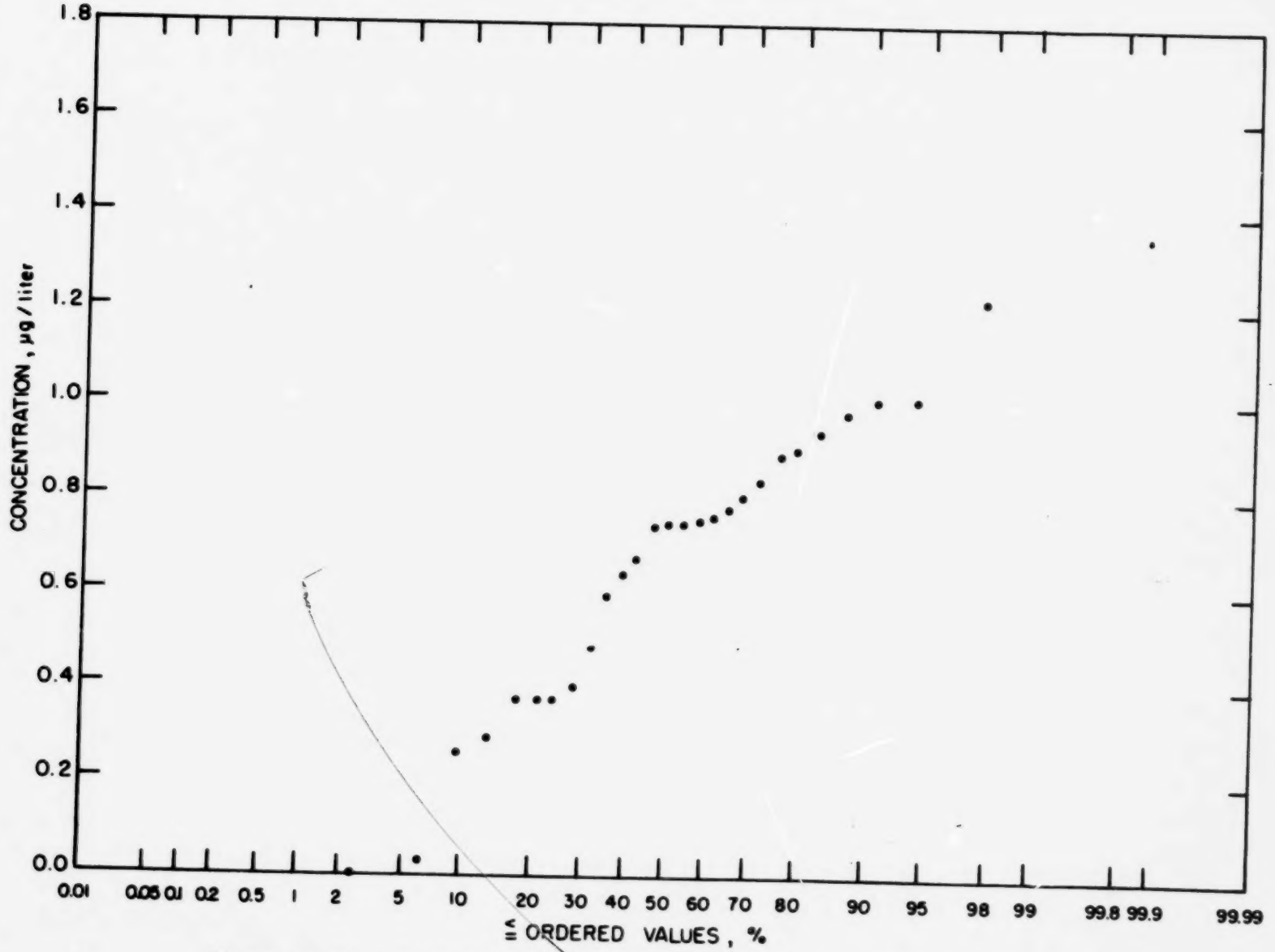


Figure B-15. Probability curve for dieldrin in water sample A.

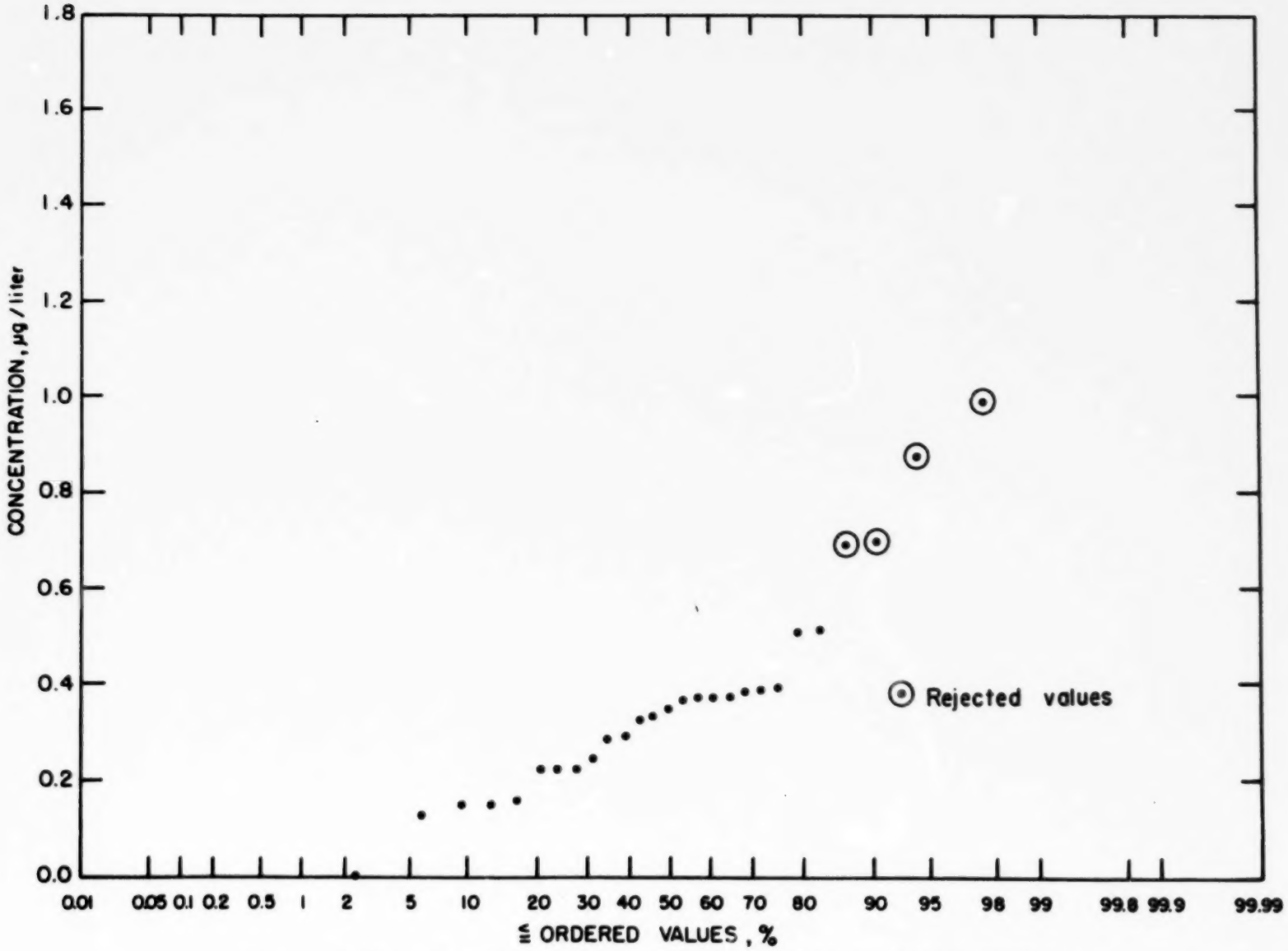


Figure B-16. Probability curve for dieldrin in water sample B.

## APPENDIX C.

## GLOSSARY OF STATISTICAL TERMS

A glossary of statistical terms defined as they are used in this report is presented to ensure uniform and complete understanding.

**Arithmetic mean** — The sum of a series of test results divided by the number of tests in the series.

**Median** — Halfway point in the readings when they have been arranged in order of size (the middle reading of an odd number of readings, or the average of the middle two for an even number).

**Accuracy** — The correctness of a measurement, or the degree of correspondence between the results and the true value (actual amount added).

**Accuracy data** — Measurements that relate to the difference between the average test results and the true value when the latter is known or assumed. The following measures apply:

50% Range – Shortest interval falling around the true value within which 50% of the data lies. For odd size sample, it is 50% rounded up.

Average deviation from true value – Average difference (when always considered as positive) between the mean determination for each laboratory and the true value.

Average percent deviation from true value – Average of the differences between a laboratory's replicate results and the true value expressed as percentages of the true value.

Mean error – The average difference with regard to sign of the test results from the true results. Also equal to the difference between the average of a series of test results and the true results.

Relative error – The mean error of a series of test results as a percentage of the true result.

| | |
|---|---|
| Precision | A measure of the reproducibility of measurements, or the degree to which the measurements correspond to one another. |
| Precision data | Measurements that relate to the variation among the test results themselves, i.e., the scatter or dispersion of a series of test results without assumption of any prior information. The following measures apply: |

Variance – Sum of squares of deviations of the average test results from the mean of the series divided by one less than the total number of average test results.

Standard deviation – Square root of the variance.

Coefficient of variation – Standard deviation expressed as a percentage of the mean of a series of laboratory results.

Range – Difference in magnitude between the highest and lowest laboratory mean.

Average percent deviation within laboratory – Average of the differences between the replicate results from a laboratory and the mean of their results, expressed as percentage of their mean.

Confidence limits – Limits within which the true mean of the population (the theoretically infinite number of possible replications of the analysis) will lie with a given probability.

## APPENDIX D.

## ANALYTICAL REFERENCE SERVICE MEMBERSHIP

### STATE AGENCIES

Alabama Water Improvement Commission, Montgomery
Arizona State Department of Public Health, Phoenix
Arkansas State Department of Health, Little Rock
California Department of Water Resources, Los Angeles
California Department of Water Resources, Sacramento
California State Department of Public Health, Los Angeles
California State Department of Public Health, Air and Industrial Hygiene Laboratory, Berkeley
California State Department of Public Health, Sanitation and Radiation Laboratory, Berkeley
Colorado Department of Public Health, Denver
Connecticut State Department of Health, Hartford
Delaware Water Pollution Commission, Dover
Florida State Board of Health, Jacksonville
Florida State Board of Health, Miami
Florida State Board of Health, Pensacola
Florida State Board of Health, Winter Haven
Georgia Department of Public Health, Atlanta
Hawaii Department of Health, Laboratories Branch, Honolulu
Hawaii Department of Health, Occupational and Radiological Health Section, Honolulu
Idaho Department of Health, Boise
Illinois Department of Air Pollution Control, Chicago
Illinois Department of Public Health, Springfield
Illinois Department of Public Health, State Sanitary Water Board, Springfield
Illinois State Water Survey Division, Champaign
Indiana State Board of Health, Indianapolis
Iowa State Hygienic Laboratory, Iowa City
Kansas State Department of Health, Topeka
Kentucky State Department of Health, Division of Laboratory Services, Frankfort
Kentucky State Department of Health, Public Health Laboratories Division, Frankfort
Kentucky State Department of Health, Radiological Health Program, Frankfort
Louisiana State Board of Health, New Orleans
Maryland State Department of Health, Baltimore
Massachusetts Department of Public Health, Amherst
Massachusetts Department of Public Health, Boston
Michigan State Department of Health, Lansing

Michigan Water Resources Commission, Lansing
Minnesota Department of Health, Engineering Laboratories Section, Minneapolis
Missouri Department of Public Health and Welfare, Jefferson City
Montana Bureau of Mines and Geology, Butte
Montana State Board of Health, Helena
Nebraska Department of Agriculture and Economic Development, Lincoln
Nebraska State Department of Health, Division of Radiological Health, Lincoln
Nevada State Department of Health, Las Vegas
Nevada State Department of Health, Reno
New Hampshire Department of Health, Concord
New Hampshire Water Pollution Commission, Concord
New Jersey State Department of Health, Trenton
New Jersey State Department of Health, Environmental Health Laboratories, Trenton
New Mexico Department of Public Health, Santa Fe
New York State Air Pollution Control Board, Albany
New York State Conservation Department, Oakdale, L.I.
New York State Conservation Department, Scottsville
New York State Department of Air Pollution Control, New York City
New York State Department of Health, Albany
North Carolina Department of Water Resources, Raleigh
North Dakota State Department of Health, Bismarck
Ohio Department of Agriculture, Reynoldsburg
Ohio State Department of Health, Columbus
Oklahoma State Health Department, Oklahoma City
Oregon State Board of Health, Division of Sanitation and Engineering, Portland
Pennsylvania Department of Agriculture, Harrisburg
Pennsylvania Department of Health, Bureau of Air Pollution Control, Pittsburgh
Pennsylvania Department of Health, Division of Air Pollution Control, Harrisburg
Pennsylvania Department of Health, Division of Sanitary Engineering, Harrisburg
Puerto Rico Aqueduct and Sewer Authority
Puerto Rico Institute of Health Laboratories, Hato Rey
Rhode Island State Department of Health, Providence
South Carolina Department of Agriculture, Columbia
South Carolina Pollution Control Authority, Columbia
South Dakota Department of Health, Pierre
Tennessee Department of Public Health, Division of Industrial Hygiene Service, Nashville
Tennessee Department of Public Health, Radiological Health Service, Nashville
Tennessee Stream Pollution Control Board, Nashville

Texas State Department of Health, Austin
Texas State Department of Health, Division of Occupational Health and Radiation Control, Austin
Utah State Department of Health, Salt Lake City
Vermont Department of Water Resources, Montpelier
Vermont State Department of Health, Barre
Vermont State Public Health Laboratory, Burlington
Virginia State Department of Health, Bureau of Industrial Hygiene, Richmond
Virginia State Department of Health, Bureau of Laboratories, Richmond
Virginia State Water Control Board, Richmond
Washington State Department of Health, Seattle
Washington State Food and Drug Laboratory, Seattle
West Virginia Department of Natural Resources, Charleston
Wisconsin Department of Agriculture, Madison
Wisconsin State Laboratory of Hygiene, Madison

MUNICIPAL AGENCIES

Baltimore Health Department, Maryland
Beaumont Health Department, Texas
Bureau of Air Pollution Control and Heating Inspection, Cincinnati, Ohio
Central District Filtration Plant, Chicago, Illinois
Charlotte Water Department, North Carolina
City of Allentown, Bureau of Water, Pennsylvania
City of Amarillo, Texas
City of Durham, Department of Water Resources, North Carolina
City of Erie, Bureau of Water, Pennsylvania
City of Kingston Laboratory, New York
City of Los Angeles, Department of Water and Power, California
City of Miami, Alexander Orr, Jr. Water Treatment Plant, Florida
City of New York, Department of Health, New York
City of New York, Department of Health, Food and Drug Laboratory, New York
City of Niagara Falls, Division of Water Laboratories, New York
City Water Department of Chattanooga, Tennessee
City of Yonkers, Bureau of Water, New York
Department of Health and Hospitals, St. Louis, Missouri
Department of Public Works and Utilities, Flint, Michigan
Department of Service and Buildings, Dayton, Ohio
Erie County Laboratory, Buffalo, New York
Fresno Department of Public Health, California
Houston Health Department, Texas
Lawrence Experiment Station, Massachusetts
Long Beach Water Department, California
Los Angeles Air Pollution Control District, California
Los Angeles County Air Pollution Control District, California
Los Angeles County Flood Control District, California
Los Angeles Department of Public Works, California

Louisville Water Company, Kentucky
Metropolitan Utilities District, Omaha, Nebraska
Metropolitan Water District of Southern California, La Verne, California
Minneapolis Water Department, Minnesota
Monroe County Department of Health, Rochester, New York
Nassau County Department of Health, Hempstead, New York
Nassau County Department of Health, Mineola, New York
Newburgh Water Department, New York
North Jersey District Water Supply Commission, Wanaque
Orange County Air Pollution Control District, Anaheim, California
Pasadena Department of Public Health, California
Philadelphia Department of Public Health, Environmental Health Laboratory, Pennsylvania
Philadelphia Department of Public Health, Public Health Laboratory, Pennsylvania
Philadelphia Suburban Water Company, Bryn Mawr, Pennsylvania
Philadelphia Water Department, Pennsylvania
Philadelphia Water Department, Belmont Laboratory, Pennsylvania
Philadelphia Water Department, Torresdale Laboratory, Pennsylvania
St. Louis County Water Company, Missouri
Springwells Filtration Plant, Dearborn, Michigan
Topeka Water Department, Kansas
Water Pollution Control Board, Cincinnati, Ohio

FEDERAL AGENCIES

Associated Universities Incorporated, Brookhaven National Laboratory, Upton, Long Island, New York
DHEW, Food and Drug Administration, Chicago, Illinois
DHEW, Food and Drug Administration, Division of Pharmacology, Washington, D. C.
DHEW, PHS, Air Pollution Technical Information Center, Division of Air Pollution, Washington, D. C.
DHEW, PHS, Communicable Disease Center, Savannah, Georgia
DHEW, PHS, Division of Dental Public Health, Bethesda, Maryland
DHEW, PHS, Division of Environmental Engineering and Food Protection, Washington, D. C.
DHEW, PHS, Great Lakes-Illinois River Basins Project, Chicago, Illinois
DHEW, PHS, Information and Education Office, Division of Air Pollution, Washington, D. C.
DHEW, PHS, Interstate Carrier Branch, Division of Environmental Engineering and Food Protection, Washington, D. C.
DHEW, PHS, Northeast Shellfish Sanitation Research Center, Narragansett, Rhode Island
DHEW, PHS, Northeastern Radiological Health Laboratory, Winchester, Massachusetts
DHEW, PHS, Office of Chief, Division of Water Supply and Pollution Control, Washington, D. C.



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DHEW, PHS, Ohio River Basin Project, Division of Water Supply and Pollution Control, Wheeling, West Virginia
DHEW, PHS, Pacific Northwest Water Laboratory, Corvallis, Oregon
DHEW, PHS, Radiological Health Laboratory, Rockville, Maryland
DHEW, PHS, Regional Office IV, Atlanta, Georgia
DHEW, PHS, Research and Training Grants Branch, Division of Water Supply and Pollution Control, Washington, D.C.
DHEW, PHS, Southeastern Radiological Health Laboratory, Montgomery, Alabama
DHEW, PHS, Southwestern Radiological Health Laboratory, Las Vegas, Nevada
DHEW, PHS, Technical Services Branch, Division of Water Supply and Pollution Control, Washington, D.C.
DHEW, PHS, Water Quality, Division of Water Supply and Pollution Control, Cincinnati, Ohio
District of Columbia Department of Public Health, Washington, D.C.
Fourth U.S. Army Medical Laboratory, Fort Sam Houston, Texas
Oak Ridge Institute of Nuclear Studies, Oak Ridge, Tennessee
Pearl Harbor Naval Shipyard, San Francisco, California
Regional Environmental Health Laboratory, McClellan AFB, California
San Francisco Bay Naval Shipyard, Vallejo, California
Sixth U.S. Army Medical Laboratory, Fort Baker, California
Tennessee Valley Authority, Chattanooga, Tennessee
Tennessee Valley Authority, Wilson Dam, Alabama
2794th USAF Dispensary, Kelly AFB, Texas
USAF Hospital (HWEBB), Wright Patterson AFB, Ohio
U.S. Army Environmental Hygiene Agency, Edgewood Arsenal, Maryland
U.S. Bureau of Sports, Fisheries, and Wildlife, Fish-Pesticide Research Laboratory, Denver, Colorado
U.S. Department of the Interior, Bureau of Reclamation, Denver, Colorado
U.S. Department of the Interior, Geological Survey, Columbus, Ohio
U.S. Department of the Interior, Geological Survey, Denver, Colorado
U.S. Department of the Interior, Geological Survey, Little Rock, Arkansas
U.S. Department of the Interior, Geological Survey, Philadelphia, Pennsylvania
U.S. Department of the Interior, Geological Survey, Sacramento, California
Walter Reed Army Medical Center, Washington, D.C.
Water Pollution Control Federation, Washington, D.C.

FOREIGN AGENCIES

British Coke Research Association, Chesterfield, Derbyshire, England
Central Electricity Research Laboratories, Leatherhead, Surrey, England
City's Institute for Health Protection, Belgrade, Yugoslavia
Comissao Inter-Municipal de Controle da Poluicao das Aguas E Do Ar, Sao Paulo, Brazil
Department of Health Services and Hospital Insurance, Vancouver, Canada
Department of Mines and Technical Survey, Ottawa, Ontario, Canada

Department of Municipal Laboratories, Hamilton, Ontario, Canada
Department of National Health and Welfare, Vancouver, Canada
Department of National Health and Welfare, Occupational Health Division, Ottawa, Ontario, Canada
Department of National Health and Welfare, Public Health Engineering Division, Ottawa, Ontario, Canada
Instituto Nacional de Obras Sanitarias, Caracas, Venezuela
Israel Institute of Technology, Haifa, Israel
Metropolitan Corporation of Greater Winnipeg, Manitoba, Canada
Metropolitan Water, Sewage, and Drainage Board, Sydney, Australia
Ministere de la Sante, Montreal, Quebec, Canada
National Institute of Hygienic Sciences, Tokyo, Japan
National University of Colombia, Bogota, Colombia
Newcastle and Gateshead Water Company, Newcastle Upon Tyne, England
Obras Sanitarias de la Nacion, Buenos Aires, Argentina
Ontario Water Resources Commission, Toronto, Ontario, Canada
Permutit Company, Limited, London, England
Public Health Laboratory Service, London, England
Scientific Research Council, Kingston, Jamaica, West Indies
Taiwan Institute of Environmental Sanitation, Air Pollution and Radiological Health Section, Taipei, Taiwan, China
Taiwan Institute of Environmental Sanitation, Division of Water Quality and Pollution Control, Taipei, Taiwan, China
Taiwan Institute of Environmental Sanitation, PHA, Taiwan, China
Taiwan Institute of Environmental Sanitation, Taichung Water Laboratory, Taichung, Taiwan, China
Taiwan Institute of Environmental Sanitation, Tainan Water Laboratory, Tainan, Taiwan, China
Taiwan Institute of Environmental Sanitation, Taitung Water Laboratory, Taitung, Taiwan, China
Taiwan Institute of Environmental Sanitation, Training Section, Taipei, Taiwan, China
United Kingdom Atomic Energy Authority, Didcot, Berks, England
University of Beograd, Yugoslavia
University of Leeds, England
Waste Water Research Laboratory of the Swedish Forest Industries, Stockholm, Sweden
Water Research Association, Marlow, Buckinghamshire, England

UNIVERSITIES

University of California, Richmond
University of California, Riverside
University of California, Engineering Material Laboratory, Berkeley
University of California, Industrial Hygiene Engineering, Berkeley
Clemson University, South Carolina
Columbia University, Plainsboro, New Jersey
Cornell University, Ithaca, New York
University of Dayton, Ohio

Drexel Institute of Technology, Philadelphia, Pennsylvania
Fairleigh Dickinson University, Madison, New Jersey
University of Florida, College of Engineering, Gainesville
Iowa State College, Ames
University of Kansas, Lawrence
Louisiana State University, Baton Rouge
University of Minnesota, Minneapolis
University of North Carolina, Chapel Hill
University of Pittsburgh, Pennsylvania
Purdue University, Lafayette, Indiana
Rennselaer Polytechnic Institute, Troy, New York
Rutgers - The State University, Department of Agricultural Chemistry, New Brunswick, New Jersey
Rutgers - The State University, Department of Environmental Science, New Brunswick, New Jersey
St. Mary's College, Winona, Minnesota
University of Vermont, Burlington
Washington State University, Pullman

INDUSTRIES

American Cyanamid Company, Wayne, New Jersey
Anaconda Company, Grants, New Mexico
Battelle Memorial Institute, Columbus, Ohio
Bender Hygienic Laboratory, Albany, New York
Bethlehem Steel Company, Bethlehem, Pennsylvania
Bio-Technics Laboratories, Incorporated, Los Angeles, California
Borg-Warner Corporation, Des Plaines, Illinois
Brown and Caldwell Laboratories, San Francisco, California
Calgon Corporation, Pittsburgh, Pennsylvania
California Water Service Company, San Jose, California
Chrysler Corporation, Detroit, Michigan
Culligan Incorporated, Northbrook, Illinois
Dow Chemical, Midland, Michigan
E. I. du Pont de Nemours and Company, Aiken, South Carolina
Ekroth Laboratories, Incorporated, Brooklyn, New York
FMC Corporation, Pocatello, Idaho
Fairbanks, Morse and Company Research Center, Beloit, Wisconsin
General Electric Company, Louisville, Kentucky
Good Year Atomic Corporation, Piketon, Ohio
H. C. Nutting Company, Cincinnati, Ohio
Hammond-Montel, Incorporated, Elmhurst, New York
Havens-Emerson, Oradell, New Jersey
Hazleton Nuclear Science Corporation, Palo Alto, California
Holzmacher, McLendon and Murrell, Melville, New York
Industrial Chemicals, Incorporated, South Bend, Indiana
INFILCO, General American Transportation Corporation, Tucson, Arizona

Ionics, Incorporated, Watertown, Massachusetts
Johns-Manville Research and Engineering Center, Manville, New Jersey
Kem-Tech Laboratories, Incorporated, Baton Rouge, Louisiana
Kennecott Copper Corporation, Salt Lake City, Utah
Magnus Chemical, Garwood, New Jersey
Mallinckrodt Chemical Works, St. Louis, Missouri
Maryland Cooperative Milk Producers, Incorporated, Baltimore, Maryland
McCrone Associate, Incorporated, Chicago, Illinois
Midwest Research Institute, Kansas City, Missouri
Minute Maid Company, Anaheim, California
Monsanto Company, St. Louis, Missouri
NALCO Chemical Company, Chicago, Illinois
New Mexico Institute of Mining and Technology, Socorro
Nuclear-Chicago Corporation, Des Plaines, Illinois
Pacific Gas and Electric Company, Emeryville, California
Pacific Gas and Electric Company, San Francisco, California
Pan American World Airways, Patrick Air Force Base, Florida
Pomeroy, Johnston and Bailey, Pasadena, California
Radiation Applications, Incorporated, Long Island, New York
Radiation Detection Company, Mountain View, California
Ray W. Hawksley Company, Incorporated, Richmond, California
Reynolds Electrical and Engineering Company, Incorporated, Las Vegas, Nevada
Roy F. Weston, Incorporated, West Chester, Pennsylvania
Sandia Corporation, Albuquerque, New Mexico
Shell Chemical Company, Princeton, New Jersey
Southern Testing and Research Laboratories, Incorporated, Wilson, North Carolina
Tracerlab, Incorporated, Richmond, California
U.S. Industrial Chemicals Company, Tuscola, Illinois
W.R. Grace and Company, Dearborn Chemical Division, Lake Zurich, Illinois
Water Service Laboratories, Incorporated, New York, New York



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